Repulsion Between Strap Conductors—Precautions to be Taken in Operating Alternators in Parallel—and the Regular Departments

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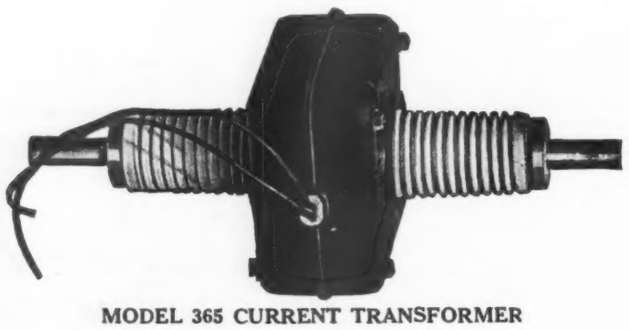

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Street-Lighting Poles and Fixtures

THE article by James R. Cravath printed this week concerns a subject where common sense and an appreciation of the fitness of things are peculiarly valuable. It takes up the very practical question of the poles and fixtures for street lighting in small places. As a rule sins against good taste are more common in such communities than in large cities, where, if the equipment is not artistic, it is at least in the main inoffensive. The prevailing vice of small and growing municipalities is a cheap attempt at distinguished magnificence. There are plenty of places where a bronze standard of highly decorative design bearing a group of graceful fixtures is both appropriate and artistically desirable. An imitation of the same thing in painted concrete, installed on a boulevard where razor-back hogs may still be seen running in the gutters, is humorous instead of impressive. To those who have a keen appreciation of the fitness of things Mr. Cravath's good advice will be singularly welcome. The mere statement that when street lamps are supplied with energy from overhead circuits it is useless to make the lamp-supporting poles more expensive and ornamental than the line poles on the same street covers the esthetic principles of the situation.

Wood, steel and concrete all have their places in carrying poles for electric lamps. All of these can be made neat and comparatively inexpensive, and if properly designed a certain ornamental value can be given to them. For most situations, in fact, inconspicuousness is the chief merit, whether for poles carrying lamps or those carrying wires only. In places suitable for decorative effects by day as well as by night the ornamental forms of lamp support may be desirable and justified by the conditions. The center suspended lamp or, more broadly, a lamp placed far out in the street is always a puzzle from the artistic viewpoint. Short brackets, up to 6 feet or 8 feet (1.8 m. or 2.4 m.), if the lamps are carried rather high, can be made of graceful design. When, however, it comes to reaching the center of a 40-foot (12.2-m.) street the trouble begins. Mr. Cravath's suggestion of steel poles set in concrete with a slight rake and pulled up true by the span wire is an extremely good one, particularly in these days of big gas-filled units of which the hanging weight is not considerable. About the only other refuge in such cases is the long mast arm, always ugly in itself, but sometimes comparatively inoffensive when carried well up so as to show only against the foliage of the trees which compel its use, and painted so as to be inconspicuous. The common sense of Mr. Cravath's advice should appeal to every one who has to deal with the problem.

Effect of the War on Industrial Research

IT IS curious to notice the profound but varied influences which the war exerts upon industrial researches in different places. Industrial laboratories which have regularly conducted researches have been sadly depleted by the demand for armies and for army munition makers of all kinds. Consequently many industrial researches have had to be postponed on account of the war. However, interference with normal trade relations and the interruption of certain necessary supplies have served to stimulate industrial research in all the allied countries. The war has demonstrated to a vast number of industries that had previously remained content to distribute merely and to let some one else do the investigating the necessity of maintaining researches. It is likely that this salutary lesson will make an indelible impression on many industries, so that in future those affected will be likely to keep up with the front ranks of progress by independent pioneer efforts. Consequently, the war has developed, or at least initiated, a number of new lines of industrial research.

Moreover, the conduct of the war itself is demanding an abnormally and incredibly large amount of technical investigation and research. Military men say that the mode of fighting which was correct three years ago is now as extinct as the dodo in the military schools. A large amount of the change is the result of experience under the guidance of military industrial research.

It is interesting to note that, according to our information, the American Institute of Electrical Engineers intends to devote a meeting before long to the subject of industrial research. The discussion at that meeting should elicit more than usual interest at this stage of the world struggle between autocracy and democracy, because the issue in the struggle largely depends upon the relative effectiveness of co-operative effort, including industrial research, which the two opposing systems of conducting community life can maintain.

Coal Conservation

THE time has come when all electric supply stations must take counsel with themselves as to ways and means of keeping down the increasing cost of coal. Just how serious the situation may become cannot now be told, particularly since the government is not yet in position to act with full knowledge on matters of mining costs and transportation. Very much, however, in the way of remedial measures lies within the reach of the stations themselves. We are confronted not only with a shortage of transportation that means, aside from all other factors, increase of cost, but also with

important changes in the nature of the commercial demand for fuel. The navy, and vessels in government service generally, will demand exceptionally large quantities of high-grade fuel. At whatever cost the fighting ships must be kept tuned up to the highest point of efficiency, particularly in view of the possible raids more than hinted at by Admiral Jellicoe. On high-grade steam coal, therefore, the government has the call, morally and legally. Moreover, for oil-burning craft there will be required a great extra quantity of oil which will inevitably disturb the economic balance existing between coal and oil. Putting it broadly, there will be a shortage of high-grade fuel which will necessarily work some hardship and is already doing so. As for means of relief, they must be sought in each individual case, in general by endeavoring to work out a change in fuel so that the demand for fuel of various grades may be more nearly equalized.

From time to time for some years past we have hammered away at the specialization of boiler-room equipment for dealing with low-grade coals. It is a well-known fact that the utilization of the poorer fuels requires a special study of furnace design and operation in order to make the best of them. Sometimes it is a matter of radical change of equipment, which may be well worth while if we must look forward to a long period of disturbed conditions, sometimes only minor rearrangements, or in hand-fired furnaces special instruction of the fireman. But it is evidently necessary that preparations should be made for economy's sake, so that all things burnable may be efficiently utilized. The long and short of it is that we cannot count on getting the customary grades of steam coal in adequate amounts, and must perforce turn attention to burning what can be had. Whether the government will pursue the British plan of saving in transportation by deflecting the output of certain coal areas into specific regions cannot now be told. If it should do so, the limitations of fuel would become at once apparent, and it would be much easier to take account of them. It would be the part of wisdom as things now are to assume that the equivalent of such a step is the natural outcome of the situation. The main point is that it is up to all operating engineers to get busy and see what they can do with somewhat unwonted fuels which offer the chance of economy.

It is an unpleasant situation, yet it may yield large results in the future and will tend greatly to conserve the general fuel supply when the stress is relieved. During the great coal strike some years ago householders learned that heating apparatus could be run successfully on fuels that it had never before entered their minds to use, and one of the technical outcomes was a study of the smokeless combustion of soft coals which ultimately was of considerable use. Just such a sort of evolution has got to take place in the central station's method of making steam, and the sooner all hands get at it the less trouble will be caused. Further, whatever the fuel, it is going to be relatively high in price, and every coal-saving economy known to the art should be played for all it is worth, with a rigor never before so absolutely necessary. Special efforts should be made to keep machines running at their maximum efficiency and boilers worked at their most economical point. While this is supposed to be generally done, there are many plants in which a little extra care and tact in load distribution would make a material daily saving in fuel. Particular discretion, too, should be used in taking on load so as to keep the load factor at the highest possible point. Finally, there should be persistent efforts made to get everything possible out of the hydraulic resources of the country, using transmitted power as skillfully as possible to keep down coal consumption and to steady the load required from the steam units. It is not safe to indulge in any optimistic dreams of troubles soon over. They may last a long time, and even if they do not the lessons in economy learned under the pressure of present needs will in the long run prove profitable.

Repulsion Between Strap Conductors

IT HAS been known ever since the original experiments of Ampère that active electric conductors exerted mutual attractions or repulsions. Two parallel wires which carry currents in the same direction appear to feel a mutual bond of sympathy and pull together with a tendency to coalesce into a single wire. On the other hand, when two such wires carry oppositely directed currents, like the going and returning conductors of one and the same circuit, they act as though they loathed each other and they try to escape from each other's vicinity. Ordinarily, these forces between active parallel conductors are insignificantly small. Thus, if a pair of parallel going and returning conductors are separated by an interaxial distance of 2 centimeters, and the current in them is 10 amperes, their mutual repulsion will amount to only 1 dyne per linear centimeter, or about 30 milligrams weight per linear foot. In electric signaling, or in weak-current electrical work generally, the men engaged in it might never be led to suspect the existence of such forces. On the other hand, however, these ever-lurking forces increase as the square of the current strength; so that if the two wires just considered carried 10 kiloamperes, or 1000 times as much current as before, the force would be magnified a million times, and the mutual repulsion would be 1 megadyne per centimeter, or 30 kilograms per linear foot, a very respectable push, which might readily deform the structural supports if these were not adequately designed.

With the growth of central stations delivering powerful currents and subject to possible short circuits, these electrodynamic forces become increasingly important to engineers. Unless busbars are well braced, they may at the instant of some unexpected short circuit rise up in their might and move in a rapid and indignant way.

In the case of round copper rods, the magnitude of these electrodynamic forces is relatively easy to compute. Large copper busbars are, however, rarely constructed in the form of round rods, partly on account of the relatively small surface and consequent large heating with the circular cross-section. The more usual form is that of a strap or group of straps, and

then the computation is more difficult. This case is dealt with very neatly in an article by H. B. Dwight on another page. The formula arrived at is lengthy, but the curves supplied enable a solution to be quickly obtained for any given geometrical relation between parallel rectangular straps. It is interesting to observe that, except when the straps lie in one plane, the force is less and sometimes much less than when the conductors are rods of the same cross-section.

If we consider a loop of conductor carrying constant current, the electromagnetic energy of the loop depends upon the product of the flux linked with the loop and the current carried. The loop always tries to increase this energy, by spreading itself, so as to embrace more flux. In spreading itself half the increment of energy goes into the mechanical work of the spread, and half into extra kinetic energy of current. Consequently, if we can compute the increase of inductance in the loop due to a small displacement, and so the change in electrokinetic energy, we know that an equal amount of energy has been expended in mechanical displacement, and we can find the magnitude of the force involved. With rectangular cross-sections, or strap conductors, the change of linear inductance with displacement is a somewhat difficult problem, and Mr. Dwight's presentation of the result in graphical form will be very acceptable to designing engineers.

"Hunting" and Its Remedy

THE phenomenon of "hunting" is less common now than formerly, owing to the better design of prime movers and governors and in part to the more general use of large machines with heavy rotating parts which render them immune from certain varieties of periodic disturbances. William Knight's brief paper on this subject in another column is a particularly neat and finished discussion of the broad facts in the case. The substance of it should find its way into textbooks of engineering, in which the subject is too often now dismissed with a brief note. There are two contending factors which must be considered, the moment of inertia of the rotating parts and the dynamical restoring moment tending to resist displacement of the rotating member from its position of rest or steady motion. With a uniform torque applied and uniform load on the electrical side stability is automatic. If either torque or load is irregular, the rotating part must take up a new position of equilibrium. If the irregularity is aperiodic, no permanent disturbance will be created; if periodic, the disturbance will be reflected only in small periodic shifts of equilibrium, unless the periods of the two opposing moments bear such a periodic relation to each other that the reactions are additive. When this occurs there will be trouble from hunting unless damping forces are applied. Mr. Knight in his article shows how the situation works out in practice and how the respective periods due to moment of inertia and disturbing forces are numerically related, giving a very finished synopsis of the fundamental facts. Although directly aimed at the parallel running of alternators, the explanation and formulas apply with very slight change to all cases of periodic disturbances in an electric system containing synchronous machines and should find their way into the notebook of every engineer interested in alternating-current practice.

Changing Grade of Conduits

IN A growing community it frequently happens that the grade of streets is changed, to the considerable inconvenience of utilities installed therein. Electric companies are less frequently inconvenienced than others in this way, because as a rule grading takes on a fairly permanent form before the electrical development reaches the underground stage. Sometimes, however, trouble occurs, and F. L. Rohrbach's description of how the situation was met in Spokane, Wash., will doubtless be of service to others. The Spokane situation involved both possible phases of the trouble, dropping a conduit line for lowered grade and building up another above the street surface to meet a subsequent rise in grade. In each case the system had to be kept in service while the change was made. In the former instance the lines were of fiber duct laid in concrete and the operation after cutting through the ducts to allow for the slight change of length in the rigid body was simple. The whole length was blocked up and then very cautiously lowered by jacks to its new position, after which the necessary cuts in the structure were repaired, when the lines settled down to duty at their new level without interruption.

The second task involved the building of about 1000 feet (304 m.) of temporary duct line above grade and the demolition of the old duct line. Here the cables had to be cut around temporarily, and then the temporary conduit of wooden troughs containing the cables packed in coarse sand was built and connected in. The illustrations in Mr. Rohrbach's article give a good idea of the nature of the work and its execution.

The Coming Issues

THE fourth article on street lighting for small cities and towns by James R. Cravath will be devoted to residential districts. The subject will be treated from three viewpoints: (1) Streets that are closely settled and paved, (2) streets that are outlying or sparsely settled in very small towns, and (3) extra-fine residence streets, where special lighting treatment is desired. Practical limits of efficiency have been about reached for modern dynamos, and the big problem now is to cheapen further the cost of production and increase the size of units. The largest obstacle to this problem is the rate at which heat can be dissipated. This subject will be described in the next issue and some definite data, arrived at from painstaking research, will be given. The second installment of the article on the rehabilitation of the Ashley Street station of the Union Electric Light & Power Company, started in the Aug. 4 issue, will be printed in the Sept. 29 issue.

Street-Lighting Poles and Lamp Supports

An Outline of Equipment That Has Been Found Adaptable to Small Cities and Towns for Residential and Business Sections with Overhead and Underground Construction

BY JAMES R. CRAVATH

In this article, the third in the series on street lighting for small cities and towns, there are described the available poles and lamp supports for the different conditions attendant upon residential and business section lighting, underground and overhead construction, with attention given to whether street or alley distribution is employed in the latter. Wood, iron, steel and concrete posts are considered.

IN CITIES of less than 50,000 population, such as we are considering here, there is seldom enough willingness to pay the extra cost of street lighting from underground wires to make it possible for anything but an overhead system to be used in residence districts generally. There are some exceptions to this which will be taken up more fully in a later article. Generally speaking, the underground construction for street lighting in such cities must be confined to ornamental posts in the business district and a few residence streets.

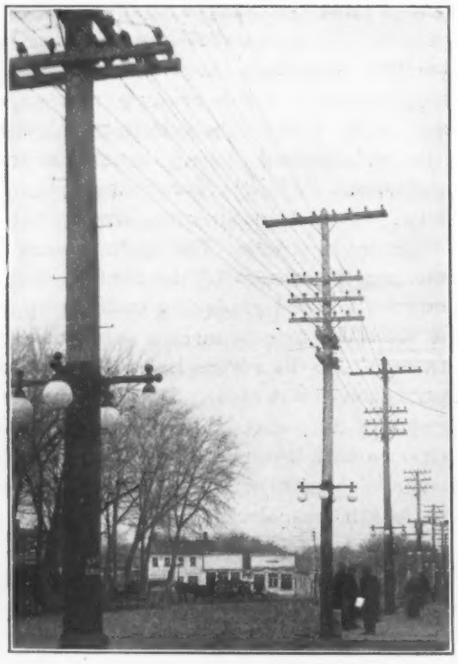


FIG. 1—NEAT OVERHEAD LINE BETTER THAN UNSIGHTLY MIXTURE OF OVERHEAD AND UNDERGROUND

OVERHEAD CONSTRUCTION

For streets where the supply is from overhead lines it is obviously useless to spend money on lamp-supporting poles that are more expensive and ornamental than the line poles on the same street. The lamp and line poles should be consistent and uniform. The usual construction is plain unpainted wood poles. A better appearance at a higher cost is had with the use of painted wood poles carefully selected for appearance. Next comes tubular steel pole construction, and finally concrete.

Ordinary wood-pole construction is so common that not much need be said, except to remind the central station company that neatness and good maintenance, whereby poles are kept plumb, cross-arms square and secure, wires reasonably tight and guys taken up, are conducive not only to safety and reliable service but to favorable public sentiment.

An example of what can be done with neat wood-pole construction where the main pole lines could not be put in alleys is shown in Fig. 1. Here the wood poles, which had to be on the street anyway to support commercial service, are so neat in appearance as to make suitable supports for the ornamental lighting brackets. Such treatment is more consistent than ornamental iron lamp poles interspersed with wooden poles of inferior quality.

FIG. 2—LIGHT STEEL POLES ARE DESIRABLE FOR CARRYING OVERHEAD STREET CIRCUITS

When the possibility of using steel or concrete line poles for overhead street-lighting lines is considered, the difference in local conditions must be recognized between a city or district where nearly all the light and power distribution lines, except those supplying street lamps, are in the alleys and a city where all lines, both street-lighting and commercial, must be kept in the streets. In the towns and districts with alley construction the only lines in the streets are the branches or loops from the main alley lines to street lamps, and it is more feasible to use steel or concrete poles for the street lines than if the main distribution lines were in the streets. Poles to support one or two street circuit wires can be light and inexpensive, because it is not so

necessary to work upon live street-lighting circuits as on commercial circuits. Steel or steel-concrete poles are objectionable from a safety standpoint for commercial 2200-volt circuits which must be worked upon when alive. Furthermore, they are difficult to climb, unless provided with steps.

Assuming alley construction for main lines, tubular

FIG. 3—TYPICAL CLUSTER POST INSTALLATION IN SMALL CITY

steel poles can be used on streets without prohibitive expense, but of course it must be at an increased yearly rate. An example of steel-pole construction for street-lighting circuits from Champaign, Ill., is shown in Fig. 2. The majority of these poles are 3-in. (7.62-cm.) bottom and 2.5-in. (6.35-cm.) top by 25 ft. (7.62 m.) long. Their cost set in concrete is roughly double that for 6-in. (15.24-cm.), 25-ft. (7.62-m.) wood poles set in dirt. The peculiar form of lantern bracket used in this case on the standard steel pole was designed by the writer to make possible an unobtrusive but safe entrance of the heavily insulated series circuit wires to the bracket pipe, either from overhead or underground, thus permitting a uniform bracket for both overhead and underground (Fig. 7) and making future change to underground possible.

Concrete poles for overhead lines are almost beyond a reasonable expense limit for small towns. The least that can be expected is three or four times wood-pole costs for the same lengths. Fig. 4 shows the Toronto concrete pole construction and lantern used.

For the numerous locations where center-suspended lamps are advisable it is worth while to study plans for making the construction as neat as possible. It is seldom that poles less than 30 ft. (9.14 m.) long should be used and often they should be 35 ft. (10.66 m.) high. Common practice with wood poles is to guy both poles to counteract the pull of the lamp suspension. These guy wires are not particularly ornamental, but with wood poles they are perhaps better than the attempts to do away with the guy wire by giving the poles a rake to counteract span wire pull. With steel poles set in concrete and a span-wire pull calculated to pull the poles to plumb, the guy wire may be omitted without detriment to heat appearances. Considerable gain in neat appearance can be made by doing away with the swinging leads from the lamp to the line and drawing the leads tight. The rope or chain for lowering is then used for the other half of the span. The swinging leads being troublesome on account of breakage, as well as unsightly, this change is of twofold advantage.

UNDERGROUND CONSTRUCTION

Underground distribution for downtown ornamental street lamps and for a few choice residence streets is now fairly common and well within the financial reach of small cities and towns. When "white-way" lighting was first introduced the common forms of posts were of cast iron or pressed steel with a cluster of three, four or five lamps. Fig. 3, from Grinnell, Iowa, is typical of this construction in the enterprising smaller towns. In the last few years, however, these cluster lamps have been on the wane as regards popularity for new installations, and one-light posts chiefly have been installed. Fig. 9 shows a one-light post with ball globe at the top. Although the one-light post with ball globe has always had considerable popularity, and on account of its simplicity and neatness probably always will, the majority of new work has been done with the post-head type of fixture of which Figs. 5, 6 and 8 are examples.

Concrete, as shown in Figs. 6, 8 and 9, is now an active competitor of cast iron in the present field for ornamental lamp standards. Its use is rapidly on the increase on account of its durability, low maintenance cost and substantial appearance.

In Fig. 6 is shown a simple type of concrete post as made for the city of Milwaukee. The post head, however, is not the one used at Milwaukee, as a special harp design is there used. This type of post is made by the centrifugal whirling-mold process, so there is a considerable hollow space in the pole and an economical use of material. The steel reinforcement is placed near the outside.

Fig. 8 shows another type of concrete post as used at

FIG. 4—CONCRETE POSTS FOR OVERHEAD LINES

Wheaton, Ill. This type of post is of solid concrete with a pipe through the middle, lightness in this case being secured by placing the reinforcements in the rib and making them resemble a cross in cross-section.

By using an acid etching process on the exterior some

very handsome concrete finishes are obtained. Another process used to some extent is that of turning the post or column in a lathe after the concrete has partly set. By this means a variety of designs can be made up without special molds for each design.

A word of caution is in order to the small purchaser who is thinking of trying inexperienced local concrete-block makers for such posts. Concrete-post manufacture is an art in which experience is not very widespread, and while no concern has any monopoly of the brains and skill in this line, some experience and skill in post manufacture are necessary if good results as to appearances are to be looked for. Practically all concrete and metal lamp standards for underground construction are designed to be set into or upon a concrete base of some kind.

FIGS. 5 TO 9—TYPICAL METAL POST WITH MODERN HEAD; CONCRETE HOLLOW POST; CONVERTIBLE OVERHEAD TO UNDERGROUND DESIGN, SHOWING UNDERGROUND USE (SEE FIG. 2 FOR OVERHEAD USE); CONCRETE POLE, RIBBED CONSTRUCTION; CONCRETE POST WITH BALL GLOBE

It is desirable in order to avoid glare, as explained in a previous article, and also to produce a dignified architectural effect, that lamps be mounted higher than has been the common practice in some of the smaller towns and a few of the large cities. Mounting lamps only 9 ft. or 10 ft. (2.7 m. or 3 m.) high is common, largely to save post cost. An actual lamp height of 14 ft. to 16 ft. (4.2 m. to 4.8 m.) is the minimum that should be used, and it is better to maintain this height even if fewer posts are installed than could be afforded if shorter posts were used. This matter will be discussed more fully in a later article, where the various elements which influence the spacing distance will be taken up.

Post costs increase rapidly with height. For example, at the present time two of the best known makes of concrete posts can be obtained for about $20 at factory, not including any fixture or foundation, for a post 13 ft. (3.9 m.) long above the ground. For a 15-ft. (4.5-m.) post the cost is $23; for a 16-ft. (4.8-m.) post, $24; for a 22-ft. (6.7-m.) post about $32, and for a 30-ft. (9.1-m.) post about $45.

Circuit-Protecting Device

James G. Zimmerman of Milwaukee Wis., has designed a circuit-protecting device (patent No. 1,223,549) which is based upon the idea of the "pinch effect." In the secondary of an induction motor circuit is arranged a circuit breaker the operation of which is controlled by the "pinching" of a liquid resistance by an excess of current due to overload. The coil of the circuit-breaker magnet being in parallel with the liquid conducting body has the same voltage across its terminals. Current passing through the coil under normal operating conditions would not be sufficiently strong to attract the armature and overcome the action spring to complete the circuit. However, when the voltage across terminals of the liquid conducting body has increased a predetermined amount, owing to the "pinch effect" caused by the current passing through the liquid the coil will be energized to such an extent that the armature will be attracted into the closed position, whereby the coil will be energized by current. This causes the circuit breaker to open and cut off the induction motor from its source of supply.

Parallel Operation of Alternators

Discussion Regarding the Interreactions Between Prime Movers and the Corresponding Alternators When Two or More of Them, All Designed for the Same Frequency and Equal Terminal Voltage, Are Operated in Parallel

BY WILLIAM KNIGHT
Assistant Mechanical Engineer Crocker-Wheeler Company

WHEN a synchronous machine is moving ahead of its mean position with regard to another one connected in parallel with it and rotating at a uniform speed, there is a force directly proportional to their relative displacement (ordinarily not more than ±2.5 electrical degrees are allowed by electrical designers) tending to slow it down to the same speed as the uniformly rotating one. Similarly, when the rotor drops behind its mean position a force will tend to pull it ahead. This is accompanied by current surges between the machine under consideration and other machines operating in parallel with it.

If, for some reason, the resisting torque of the prime mover decreases, the rotor accelerates and its momentum increases accordingly. This causes the field system to overshoot the synchronous position by a small angle. As a result of these conditions the torque exerted by the synchronizing current will pull the rotor back. During its backward course the momentum acquired by the rotor in that direction will be large enough to make it pass the synchronous position again.

Thus there is a tendency for the rotor to oscillate back and forth from its mean position when disturbed by a temporary change of conditions; as, for instance, when switched into parallel with other machines before exact synchronism is obtained, or when the load on the machine is suddenly altered. This action is called "free oscillation." If no other oscillations should take place in synchronism (or approximately) with them, these oscillations are not likely to cause trouble with machines of normal design operating in parallel. In addition, however, the rotor is subject to a number of "forced oscillations"* impressed by the prime mover. If the period of these is the same, or approximately the same, as that of the free oscillations,* parallel operation becomes impossible and "hunting" occurs, unless the free oscillations are damped somehow.

In steam engines variation of steam pressure on the piston, or variation in pressure having its origin in the action of reciprocating parts, will cause impulses having a cycle of half a revolution. Impulses having a cycle of a full revolution are due to (a) unequal steam distribution on the two ends of the cylinder, (b) weight of reciprocating parts, and (c) difference in pressure of reciprocating parts not being alike in phase for the forward and return stroke. These statements hold true for all steam and two-stroke-cycle gas engines, no matter how many cranks or pistons are connected to the same shaft. In four-stroke-cycle gas engines the impulses complete a cycle in two revolutions, as it is very improbable that equal work is done in all cylinder ends.

*The number of free oscillations (or natural frequency) of a rotating body is the number of oscillations per second that its mass will make if subjected to a force increasing as the distance through which it is rotated. For instance, a weight suspended by a string will, if moved out of the position vertically under its point of suspension, swing to and fro by the action of gravity. The irregular turning moment of an engine consists of a number of superimposed harmonic waves. For the various impulses the number of waves per revolution may be any integral number. The number of waves per second is called forced frequency, or number of forced oscillations per second.

Effect of Relation of Forced and Free Oscillations on Phase Swinging

With a single-crank, double-acting steam engine steam is admitted to the cylinder twice every revolution. The variation of speed produced by this irregular turning moment may be considered as a periodic oscillation impressed upon the rotor, and the duration of it in seconds is $t = 60/(N \times 2)$, where N is the number of revolutions per minute. A two-crank engine having cranks at 90 deg. with each other will produce four oscillations per revolution, and the duration of an oscillation is $t = 60/(N \times 4)$. For a three-crank engine with cranks at 120 deg. $t = 60/(N \times 6)$. If t for any engine is equal, or nearly equal, to the time of a free oscillation of the rotor, resonance results, and phase swinging will keep on increasing until the alternator falls out of step.

The relative positions of the cranks of two or more sets supplying energy to the same line has also some influence in determining oscillations. Suppose that two single-crank, double-acting engines are driving two alternators working in parallel, and assume that when the crank of one of them is in the position corresponding to the maximum turning moment, the other engine is exerting the least turning moment on the other alternator. This will evidently start phase swinging between the two alternators. With very low-speed machines a convenient adjustment of the steam valves such as to secure equal work in all cylinders and synchronism of the crank positions must be resorted to in order to avoid hunting troubles. With higher-speed machines, although it is always very desirable to have a good mechanical synchronism as well as electrical, synchronism of the cranks is not easily obtained in practice.

Another source of trouble in the parallel operation of alternators is found sometimes in the performance of the engine governor. With a very sensitive governor the fluctuation in the angular velocity of the steam engine is likely to set up periodic oscillations of the controlling springs of the governor balls. This will magnify the variation in speed of the prime mover, and hunting will occur. Such an outcome may be avoided by sufficiently damping the governor so that it will not be responsive to the variation in speed produced by the varying turning moment of the crank shaft.

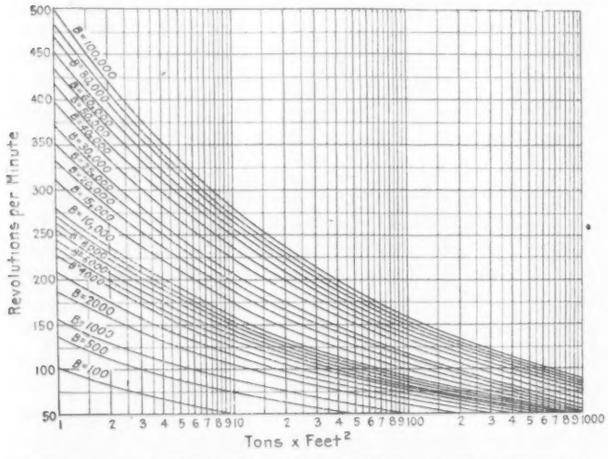
Governor drop, or regulation, which is the difference between the speeds corresponding to minimum and maximum steam pressure (no load and full load), varies from 3 to 6 per cent of the no-load speed, according to the type of governor used. A large governor drop is desirable in so far as parallel running is con-

cerned, but this will also produce a large variation of frequency between no load and full load. Hence the governor drop must be chosen large enough to permit good parallel operation, but not more than is necessary. Machines with inferior regulating properties are therefore better suited for parallel working than similar machines with a very close regulation. However, the most satisfactory result in parallel operation is secured with turbo-alternators, owing to the uniform driving torque of the turbine.

From what was said before it is evident that in order to secure good results in parallel operation of alternators it is necessary to provide a flywheel large enough to fulfill two conditions: It must limit the periodic variation in angular velocity so that the resulting displacement will not exceed ±2.5 electrical degrees and at the same time must give a natural frequency at least 25 per cent either above or below the frequency of any of the engine impulses.

METHOD OF CALCULATING PERIOD OF FREE OSCILLATION

The free oscillations of an alternator could be compared to the oscillations of a ring connected to a central shaft by means of springs. If a force is temporarily applied to the ring, tending to produce rotation in one direction, and then relieved, the springs will start the ring vibrating back and forth from its position of rest. If the disturbing force is periodically applied and the period of the disturbance coincides with the natural period of vibration of the springs, we have resonance, and the amplitude of the oscillation keeps on increasing according to an exponential law unless otherwise damped by some viscous forces. The motion of any point of the ring will be a simple harmonic function of the time, and this can be computed by using the same formula as for a pendulum.



SPEEDS AT WHICH RESONANCE OCCURS WITH DIFFERENT FLYWHEEL EFFECTS (SEE FORMULAS 10 AND 11)

$$t = 2\pi\sqrt{\frac{\Sigma mr^2}{m}}, \qquad (1)$$

Where

t = periodic time of a complete free oscillation in seconds.

Σmr^2 = mass moment of inertia of rotor and flywheel.

m = restoring moment which would act on the rotor if this were rotated from its position of rest through a unit angle.

It could be proved that the above formula, after making the necessary substitutions, can be expressed in the ft.-lb.-sec. system as:

$$t = 0.001705N\sqrt{\frac{PR^2}{\text{kw.}f\ I_o/I}} \qquad (2)$$

and, with the meter-kg.-sec. system, as:

$$t = 0.0083N\sqrt{\frac{\text{kg.-m}^2}{\text{kw.}f\ I_o/I}}. \qquad (3)$$

Where

N = revolutions per minute.

PR^2 and kg.-m^2 = flywheel effect.

kw. = output of alternator.

f = frequency in cycles per second.

I_o/I = ratio of short circuit to full-load current.

Calling w the number of waves or impulses for every revolution of the prime mover, n (forced) the number of waves or impulses per second, and n (free) the number of free oscillations per second:

$$n\ (\text{free}) = 1/t = \frac{588}{N}\sqrt{\frac{\text{kw.}f\ I_o/I}{PR^2}} \qquad (4)$$

$$n\ (\text{forced}) = wN/60. \qquad (5)$$

Parallel operation becomes impossible when n (free) $= n$ (forced), or:

$$\frac{588}{N}\sqrt{\frac{\text{kw.}f\ I_o/I}{PR^2}} = \frac{wN}{60}.$$

In this case N is the critical number of revolutions per minute. Solving for N

$$N\ (\text{critical}) = 187.7\sqrt{\frac{\text{kw.}f\ I_o/I}{w^2PR^2}}\ \text{r.p.m.} \qquad (6)$$

or, solving for the critical value of PR^2,

$$PR^2\ (\text{critical}) = 12.4 \times 10^5\frac{\text{kw.}f\ I_o/I}{N^2w^2}. \qquad (7)$$

The following values of w will give the number of impulses impressed by the prime mover on the rotor:

	Values of w
Four-stroke-cycle single-acting gas engine, one cylinder	0.5
Four-stroke-cycle single-acting gas engine, two cylinders	1
Four-stroke-cycle single-acting gas engine, four cylinders	2
Four-stroke-cycle single-acting gas engine, six cylinders	3
Four-stroke-cycle double-acting, and two-stroke-cycle, one cylinder	1
Four-stroke-cycle double-acting, and two-stroke-cycle, two cylinders	2
Four-stroke-cycle double-acting, and two-stroke-cycle, four-cylinders	4
Double-acting steam engine, one crank	2
Double-acting steam engine, two cranks	4
Double-acting steam engine, three cranks	6

Above values of w are for normal operating conditions. For special conditions, such as when one cylinder in a gas engine is missing, the value of w given for one cylinder should be used in all cases. For the case of incorrect valve setting of steam engine, use $w = 1$. For steam turbines in general use $w = 1$.

In every case the operating speed must not be closer than 25 per cent above or below the critical.

An extremely simple formula for finding the period of oscillation of m paralleled alternators running either at the same speed or at different speeds is given by Franklin Punga. The formula, because of its simplicity, is of use both to designers and engineers.

As shown before,

$$t = 2\pi\sqrt{\frac{\Sigma mr^2}{m}}.$$

The corresponding number of free oscillations per second is given by

$$n\ (\text{free}) = 1/t = \frac{1}{2\pi}\sqrt{\frac{m}{\Sigma mr^2}}. \qquad (8)$$

If $1/m = Y$ and $1/\Sigma mr^2 = J$, the natural period of

oscillation of m paralleled alternators is

$$n \text{ (critical)} = 1/2\pi \sqrt{\frac{J_1 + J_2 + \cdots + J_m}{Y_1 + Y_2 + \cdots + Y_m}}. \quad (9)$$

The values of J and Y must be based on the same speed. For instance, if alternator No. 1 has the values Σmr_1^2 and m_1 and is rotating at a speed N_1, and it is desired to use N as the normal speed, Σmr_1^2 and m_1 must be multiplied by $(N_1/N)^2$ before putting their reciprocal values in formula (9).

Mr. Punga's investigation led him to the conclusion that if the actual PR^2 of an alternator lies below the PR^2 (critical), resonance is reached by lowering the voltage. If the actual PR^2 lies above the PR^2 (critical), resonance is reached by lowering the speed.

The exact value of resonance is best found by changing the voltage at reduced speed. It must be noted that the vibration at resonance is in general too great; it can be helped, however, by approaching the critical voltage from both sides and noting the voltage at about 5 per cent above and below the critical, at which point the vibrations are quite great. In this way the PR^2 (critical) for a given alternator can be obtained experimentally.

If we make B = kw. $\times f \times I_o I \times 1/w^2$ and express PR^2 in tons-ft.,^{2} then formulas 6 and 7 become:

$$\text{R.p.m. (critical)} = 28.1 \sqrt[4]{B/\text{tons-ft.}^2} \quad (10)$$

$$\text{Tons-ft.}^2 \text{ (critical)} = 624{,}000\, B/N^4. \quad (11)$$

The last two formulas are represented graphically by the accompanying set of curves.

Changing Elevation of Underground Duct Lines

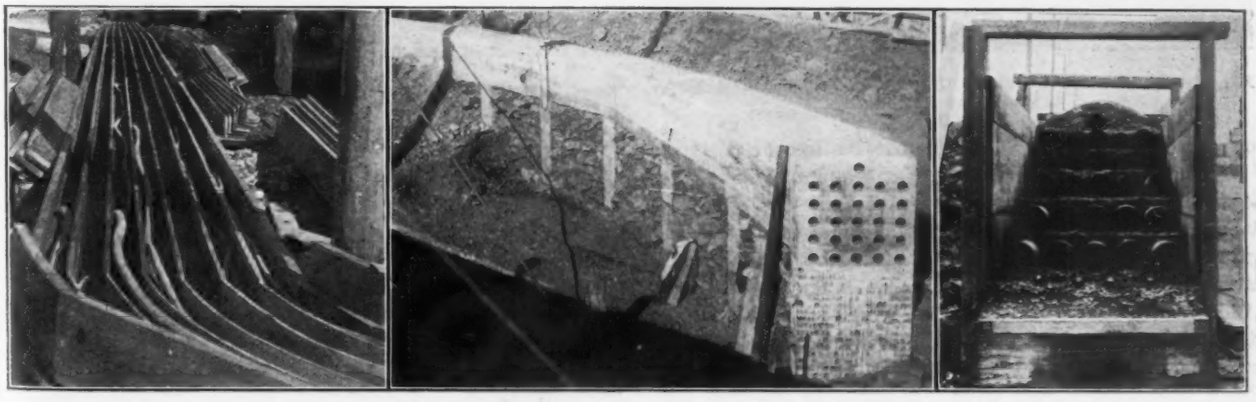
Methods of Handling Two Extremes of Construction, One Imposed by Lowering Grade of Street and the Other by Elevating the Street to Accommodate Viaduct Beneath

BY F. L. ROHRBACH
Washington Water Power Company

THE Washington Water Power Company of Spokane has recently been confronted with what might be considered the two extremes in underground conduit construction, viz., the lowering of several conduit lines without interruption to service and the building of a conduit line above the surface of the street.

The lowering of the several conduit lines was made necessary by the regrading of the streets. Three lines were affected; Howard Street, length 310 ft. (94.5 m.), maximum depth to be lowered 4 ft. (1.2 m.); Post Street, length of line 225 ft. (68.5 m.), maximum depth to be lowered 3½ ft. (1.06 m.), and Monroe Street, length of line 220 ft. (61.6 m.), maximum depth to be lowered 3 ft. (0.91 m.). Each of the three lines contained three Edison mains (500,000 circ. mil), and in addition the Post Street line included two tie lines (each 4/0 three-conductor, 13,000-volt) and an Edison feeder (1,000,000 circ. mil concentric). Each of the three lines consisted of six fiber ducts laid in concrete. The duct, which was in 5-ft. (1.5-m.) lengths and measured 3½ in. (8.9 cm.) inside diameter, had been laid in two rows of three each, the clearance between ducts being ¾ in. (1.9 cm.). The protection of concrete on the top and bottom of the duct line was 3 in. (7.6 cm.) and on the sides was 2 in. (5.1 cm.). This gave a weight of 200 lb. to 230 lb. per linear foot (297 kg. to 342 kg. per. m.) of duct line, including cables.

In regrading the streets a hump of from 3 ft. to 4 ft. (0.9 m. to 1.2 m.) was removed. This meant that the duct line had to be lowered at one point as much as 4 ft. (1.2 m.), while the ends were to stay at their original elevation. The piece of duct line to be lowered was cut through at three points, at the hump and at each end, wedges being placed in the openings to overcome any end motion. The cuts were afterward repaired, as described later.



FIGS. 1, 2 AND 3—METHOD OF SPACING TEMPORARY CABLES; SECTION OF ELEVATED DUCT, AND PARTLY COMPLETED DUCT LINE

After all gas and water pipes had been lowered, excavations were made on each side and under the duct line to be lowered, the concrete being held in its old position by blocking placed about 10 ft. (3 m.) apart. Bents made out of 8-in. by 8-in. (20.3-cm. by 20.3-cm.)

timber and spaced 8 ft. (2.4 m.) apart were then set straddle of the duct line. On top of each bent was placed a jack and sufficient blocking to allow proper clearance at that particular point. Pieces of timber, 8 in. by 8 in. by 18 ft. (20.3 cm. by 20.3 cm. by 5.5 m.) were rested on top of the jacks, there being three jacks under each timber. The duct line itself was supported by loops of ½-in. (1.27-cm.) messenger wire placed about 4½ ft. (1.36 m.) apart. Each loop of wire was drawn as tight as possible by hand and then fastened by three clamps. When everything was ready to start the actually lowering of the duct line, the jacks were screwed up slightly in order to take up any slack in the wire loops and to remove some blocking from beneath the duct line.

Owing to the fact that the duct line was not lowered the same vertical distance over its whole length, great care was necessary in handling the jacks. It was not thought necessary to use an instrument to check each jack as it was lowered, but a careful watch was kept on each wire loop so as to keep the load evenly divided. After the jacks were run down their full length, the duct line was supported from below, while blocks were

FIG. 4—FIBER DUCT LINE WHICH WAS SPLICED AFTER BEING DAMAGED BY LANDSLIDE

removed from under the jacks to give another setting.

Owing to the construction of a viaduct to accommodate a railroad it was necessary to raise a street level about 10 ft. (3 m.) and, at the same time, to give proper clearance, cut about 8 ft. (2.4 m.) below the old street level. This change affected a length of about 1000 ft. (304.8 m.) of duct line, which contained cables that had to be kept in service. Accordingly, a twenty-six-duct conduit line about 215 ft. (65.5 m.) long was built above the street level. A curve in the line was necessary in order to get from the street to a position under the sidewalk where a manhole was to be placed. Later the end of the duct line was utilized as one side of the manhole. The ducts were separated 4 in. (10.2 cm.) where they entered the manhole. At other places the separation was ¾ in. (1.9 cm.). The old duct line was torn out after the cables had been "cut around" temporarily. The pieces of fiber duct taken from this demolished line, which had been in service five years, were carefully inspected and found to be practically as good as new.

The temporary line contained fourteen ducts (two rows of seven each) and was constructed out of 1-in. (2.54-cm.) lumber except for the sides and bottom, which were 2-in. (5.08-cm.) material The wooden

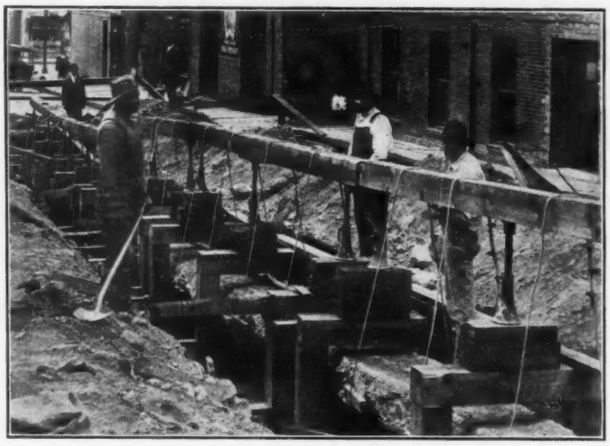


FIG. 5—METHOD OF LOWERING DUCT LINE

trough was about 800 ft. (262.4 m.) in length and contained three right-angle turns. Cables were first placed in the bottom row of ducts and the space around the cables—each duct was about 5 in. (12.7 cm.) square—then filled with coarse sand, after which the second or top row of cables was installed. No trouble was found in placing the cables in these ducts. A cable-pulling machine was placed near one end of the line and the cable fed from a reel in the usual manner, a series of large wooden spools being used to guide it around the turns of the duct line. The following cables were used in this temporary duct line: two tie lines, each 13,200 volts, three-conductor, 2/0; six railway feeders, each 1,000,000-circ. mil, four alternating-current light and power cables, each six-conductor, 1/0, and one alternating-current arc cable, seven-conductor, No. 8. Records were kept of the exact location of all joints so that in case of trouble they could easily be found. This duct line was used for a period of eight months until the viaduct was completed and duct lines were installed in the re-

FIG. 6—REPAIRING SECTION OF DUCT LINE

graded streets. The cables were then removed and placed in their permanent positions.

About a year ago one of the duct lines was badly damaged by a slide which occurred at one end of a railroad bridge abutment. The rock and gravel were cleared away as soon as possible and the duct line was

examined. It was found to be cracked in five or six places and seriously damaged at the point where it was fastened to the abutment, but none of the cables was injured. All were important cables, being tie lines between two stations. The concrete at the damaged point was cut away from around the cables and repairs were made to the duct line without any interruptions to service. Short pieces of fiber duct were first sawed lengthwise on one side only and then soaked in hot water to make them pliable. It was then a simple matter to slip the fiber over the cable, very little force being necessary to separate the duct where it had been sawed.

EFFECT OF THE WAR ON ENGINEERING COLLEGES

These Institutions Have the Largest Freshman Class in History, but Total Attendance Is Reduced—Adjustments in Curriculum

That students and faculties of the universities of the country responded nobly to the national call when war was declared is now well known. The extent to which the engineering colleges have been affected has been the subject of an investigation by the ELECTRICAL WORLD.

Reports were received from sixty-two engineering

TABLE SHOWING THE EFFECT OF THE WAR ON AMERICAN ENGINEERING SCHOOLS AND UNIVERSITY DEPARTMENTS

Name	Location	Opening Date	Percentage of Attendance Expected	Number of Faculty Absent	Rearrangement of Courses, Etc.
Alabama Polytechnic Institute	Auburn, Ala	Sept. 12	90	8	Laboratory and shop time reduced.
University of Arkansas	Fayetteville, Ark	Sept. 20	Upper, 20; freshman, full	2	Extra extension courses.
Armour Institute of Technology	Chicago, Ill	Sept. 10	100	4	None.
University of Arizona	Tucson, Ariz	Sept. 18	Fresh., 150; soph., 125; junior, 50; senior, 10	None	Military training required of all students; also courses in military engineering and geology.
Bucknell University	Lewisburg, Pa	Sept. 20	75	6	Very little.
Carnegie Institute of Technology	Pittsburgh, Pa	Sept. 20	Upper classes, 65; entering classes, 75	10%	Introduction.
Clarkson College of Technology	Potsdam, N. Y	Sept. 11	60	None	None.
Clemson Agricultural College	Clemson, S. C	Sept. 19	100	None; some new men	None so far.
Cornell University	Ithaca, N. Y	Sept. 25	75	6	Slight.
University of Colorado	Boulder, Col	Sept. 10	100	3	None.
Colorado College	Colorado Springs, Col	Sept. 12	85	5	Not settled.
University of Southern California	Los Angeles, Cal	Sept. 10	80	None	None.
De Paul University	Chicago, Ill	Sept. 24	75	3	
Drexel Institute	Philadelphia, Pa	Sept. 24, day; Oct. 1, night	Day, 50; night, 100	2 day; 5 night	Modification in evening courses.
Georgia School of Technology	Atlanta, Ga	Sept. 19	100	5	Additional military drill, also government school of aeronautics.
Haverford College	Haverford, Pa	Sept. 27	75	1	None.
Johns Hopkins University	Baltimore, Md	Oct. 2	70	1	None.
University of Illinois	Urbana, Ill	Sept. 17	80	18	None.
Iowa State College	Ames, Iowa	Sept. 10	Fresh., 100; decrease in upper classes.	4, places filled	Additional short war courses and military drill.
State University of Iowa	Iowa City, Iowa	Sept. 17	Upper, 80; fresh., 100	3	None.
Kansas State Agricultural College	Manhattan, Kan	Sept. 10	Nearly full	4 teachers, 3 fellows	None.
Lafayette College	Easton, Pa	Sept. 20	80	....	
Lehigh University	Bethlehem, Pa	Sept. 19	Larger fresh. class; upper diminished	4	None.
Lewis Institute	Chicago, Ill	Sept. 24, day; Oct. 8, night	80	8	In progress.
Massachusetts Institute of Technology	Cambridge, Mass	Sept. 24	90	5%	
Michigan Agricultural College	East Lansing, Mich	Oct. 10	75	Not yet known	None.
University of Michigan	Ann Arbor, Mich	Oct. 1	85	12—6 replaced	Additional military course.
University of Mississippi	University P. O., Miss	Sept. 19	....	35	
University of Missouri	Columbia, Mo	Sept. 17	90	2	None.
University of Nebraska	Lincoln, Neb	Sept. 12	Upper classes materially depleted	2	None.
New Hampshire State College	Durham, N. H	Oct. 3	70–85	3	Somewhat.
New Mexico College of A. & M	State College, N. M	Sept. 26	80	1–2	Added practical engineering course, using four-quarter plan.
North Carolina State Col. of Agric. & Eng	W. Raleigh, N. C	Sept. 6	90	None	Slight.
Northwestern University	Evanston, Ill	Sept. 24	85	None	None.
Norwich University	Northfield, Vt	Sept. 18	75	3	
Ohio Northern University	Ada, Ohio	Sept. 11	90	1	Yes.
Oklahoma A. & M. College	Stillwater, Okla	Sept. 6	80	None	Probably to a small extent.
Oregon Agricultural College	Corvallis, Ore	Oct. 8	90	2	None.
Pennsylvania State College	State College, Pa	Sept. 12	Upper, 75; largest fresh. class on record	7 in military service	Not important.
University of Pittsburgh	Pittsburgh, Pa	Oct. 1	65; large fresh. class	5	
Polytechnic Institute	Brooklyn, N. Y	Sept. 17	80	3	Yes.
Pratt Institute	Brooklyn, N. Y	Sept. 19	90	None	Will give instruction to 500 men in U. S. Navy which will double usual enrollment.
University of Princeton	Princeton, N. J	Sept. 25	65	....	
Rensselaer Polytechnic Institute	Troy, N. Y	Sept. 12	100	....	None.
Rhode Island State College	Kingston, R. I	Sept. 18	60 (uncertain)	1	Adjustment in special cases to allow for harvest.
University of Rochester	Rochester, N. Y	Sept. 27	....	1, place filled	No.
Ross Polytechnic Institute	Terre Haute, Ind	Sept. 19	90	1	Seniors graduate in January.
University of South Carolina	Columbia, S. C	Sept. 19	75	4, places supplied	
Leland Stanford, Jr., University	Palo Alto, Cal	Oct. 1	75–80	1–2	None.
Stevens Institute of Technology	Hoboken, N. J	Sept. 24	90	....	None.
Syracuse University	Syracuse, N. Y	Sept. 18	80	....	None.
A. & M. College of Texas	College Station, Tex	Sept. 19	90	10	Negligible.
Throop College of Technology	Pasadena, Cal	Sept. 3	75	4	Yes.
Tufts College	Tufts College, Mass	Oct. 4	90	....	None.
Tulane University of Louisiana	New Orleans, La	Sept. 24	....	....	
Union College	Schenectady, N. Y	Sept. 17	50–75	4, places supplied	Adjustments.
University of Utah	Salt Lake City	Sept. 13	90	....	Some new courses added.
University of Vermont	Burlington, Vt	Oct. 10	80	2	Yes.
Virginia Polytechnic Institute	Blacksburg, Va	Sept. 20	Fresh. and soph., 110; junior, 60; senior, 30	3	Slight.
George Washington University	Washington, D. C	Sept. 26	100	....	Courses in late afternoon.
University of Washington	Seattle, Wash	Oct. 1	....	5	Quarter system.
University of Wyoming	Laramie, Wyo	Sept. 25	50	None	None.

schools or engineering departments of universities as to the opening date, percentage of attendance expected, number of faculty absent and curriculum adjustments necessitated. It was found that the opening date extended anywhere from Sept. 3 to Oct. 10, the most popular time being the week ending Sept. 22.

The reports show conclusively that the enrollment in engineering studies this fall will be considerably reduced. Out of fifty-one replies giving figures only seven expect a 100 per cent attendance, while two expect one as low as 50 per cent. The others were divided as follows: thirteen, 90 per cent; ten, 80 per cent; nine, 75 per cent; four, 85 per cent; three, 60 per cent, and three, 70 per cent. It is safe, therefore, to say that the attendance will on the whole be from 10 to 25 per cent diminished. That these figures are not larger is owing to what seems to be the largest freshman engineering class in history. The upper classes have been severely depleted in numbers. One university expects but a 10 per cent senior attendance; others expect as low as a 20 and 30 per cent attendance in the upper classes; few report a full senior enrollment.

There is also a depletion in the ranks of the faculty. Only fifteen colleges out of the sixty-four reporting have no members of the faculty absent. The others reported 206 faculty members absent, fourteen of whom have been replaced.

In the matter of curriculum adjustments twenty-four reported none and twenty-six reported adjustments of some nature. Four have instituted military drill and courses. One is requiring of all students in engineering a course in military engineering, and one a course in military geology. One is adding a course in practical engineering, while another is reducing laboratory and shop time. An Eastern college is making adjustments to allow for the harvest. While but two reported as making a change to the quarter system, others are known to have done so. One college has decided to graduate seniors in January.

The accompanying table shows in detail the report of each college. The figures are for engineering colleges and departments only.

Repulsion Between Strap Conductors

Method of Calculation Which May Be Used in Connection with Wide, Closely Spaced Busbars or Where the Round-Wire Formula for Widely Separated Conductors Will Not Apply

BY H. B. DWIGHT
Engineer Canadian Westinghouse Company.

With the increased importance now attached to the study of short-circuit conditions in large power houses, and with the growing use of electric furnaces, the calculation of the mechanical repulsion between strap conductors is a problem of practical interest and value. When the straps are separated a considerable distance, it is possible to use with fair accuracy the usual formula for repulsion of round wires or cables, which is very simple (see equation 3). But with comparatively close spacing, as with wide busbars or in low-voltage electric furnace circuits, the round-wire formula will not apply at all closely and a different method of calculation is necessary.

In this article there is derived a formula for the repulsion of equal long parallel straight conductors of rectangular section, which applies to all relative positions, whether edgewise or in parallel planes, and whether far apart or so close as to be touching, except for insulation that may be between the conductors. This formula is not very short or convenient, and so Fig. 1 has been drawn, which gives the results of the formula with practically no calculation for the solution of engineering problems. For large spacings not indicated on this curve sheet the round-wire formula is correct within less than 5 per cent.

There are two methods of deriving the formula for the repulsion between two small wires, first, by calculating the strength of field in which one conductor lies, and, second, by calculating the differential of the mutual inductance.

In the first method the magnetic field at a distance s (expressed in centimeters) from a wire carrying a current i_1 (expressed in absolute units) is $H = 2i_1/s$. This value is obtained by integrating the effect of the current i_1 on a unit magnetic pole at distance s. Let the return wire, which lies in the magnetic field of density H, be moved a small distance ds away from the first wire. Let it be subject to a mechanical force of F' dynes per centimeter of conductor. Then the mechanical work during the above motion will be $F'ds$. The electrical work during the same motion is i_2Hds. By equating this expression to the mechanical work the following equation[1] is obtained:

$$F' = i_2H = 2i_1i_2/s \text{ dynes per centimeter of conductor.} \quad (1)$$

This expression gives the repulsion in the case of a return circuit where the currents in the two conductors are in opposite directions.

The other method,[2] which is essentially the same as the preceding one, uses the value of the mutual inductance of the two wires and involves using the formula

$$M \text{ (per cm. of one wire)} = 2\log_e 2l - 2\log_e s - 2 + 2s/l, \quad (2)$$

where l is the length of one wire. If one of the wires moves a distance ds in time dt, it cuts magnetic lines of force at the rate $i_1\,dM/dt$ and thus generates a voltage $e = i_1\,dM/dt$.

The rate of electrical working is therefore $-ei_2 = -i_1i_2\,dM/dt$, since e and i_2 are in opposite directions. The rate of mechanical working is $F'\,ds/dt$, where F' is in the direction in which s is measured. Therefore, equating the above quantities, $F' = -i_1i_2\,dM/ds = (2i_1i_2/s) - (2i_1i_2/l)$, which may be taken equal to $2i_1i_2/s$, since l is supposed very long compared with s.

The preceding formula for the repulsion of small

[1] J. J. Thomson, "Elements of the Mathematical Theory of Electricity and Magnetism," fourth edition, page 361.

[2] *Bulletin* of the Bureau of Standards, Washington, D. C., Vol. 8, No. 1, equation 99.

wires is true also for large round wires close together, since the expression for force is the differential of the expression for mutual inductance, and the latter is true for large round wires as well as small ones. Therefore $F' = 2i_1i_2/s$ dynes per centimeter of conductor, where i_1 and i_2 are in absolute units and s is in centimeters. Therefore,

$$F = \frac{2I_1I_2}{100s \times 2.54} \times \frac{2.54 \times 12}{981 \times 453.6} = (5.40I_1I_2/s)\ 10^{-7} \quad (3)$$

pounds per foot of circuit, where I_1 and I_2 are measured in amperes and s is the axial spacing in inches.

In the case of alternating currents this formula gives the average force on a conductor. It rises to double this value at the peak of the current cycle and becomes zero when the instantaneous current is zero when the currents are in phase.

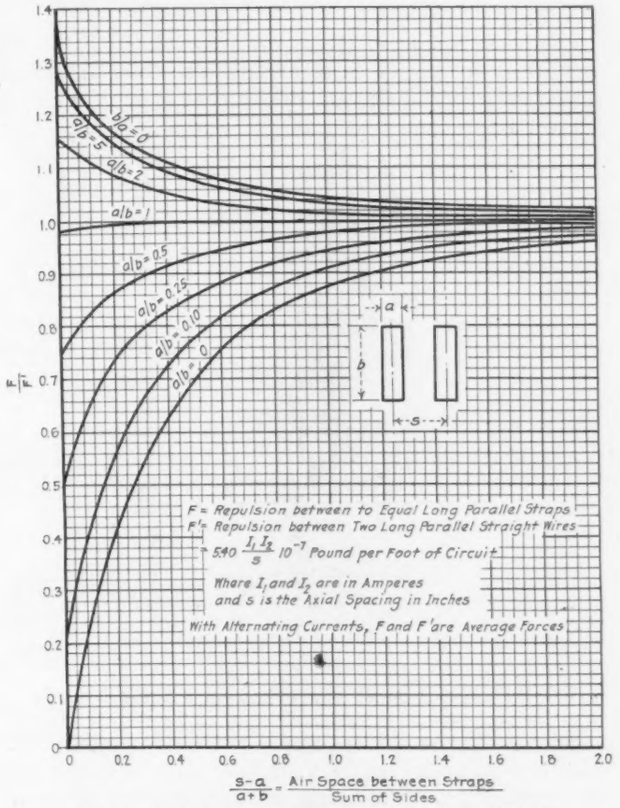

b/b=0
a/b=5
a/b=2
a/b=1
a/b=0.5
a/b=0.25
a/b=0.10
a/b=0
F = Repulsion between to Equal Long Parallel Straps
F' = Repulsion between Two Long Parallel Straight Wires
= 5.40 I1 I2 / s 10^-7 Pound per Foot of Circuit
Where I1 and I2 are in Amperes
and s is the Axial Spacing in Inches
With Alternating Currents, F and F' are Average Forces
F/F'
(s-a)/(a+b) = Air Space between Straps / Sum of Sides

FIG. 1—REPULSION BETWEEN STRAP CONDUCTORS

In finding the formula for the repulsion between two straight conductors of rectangular section, the repulsion between two equal thin sheets in parallel planes is first calculated. (See Fig. 2.) The horizontal repulsion on the long narrow strip dx caused by the similar strip dy is

$$\frac{2i_1i_2\ s\ dy\ dx}{b^2\ [s^2 + (x-y)^2]} \text{ dynes per centimeter,}$$

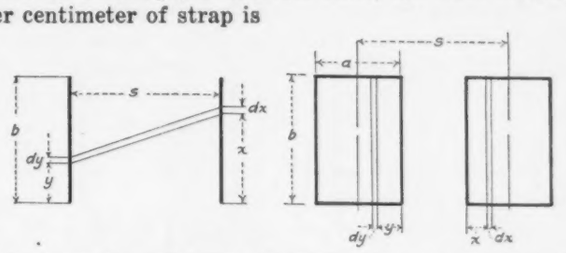
where the dimensions are in centimeters and i_1 and i_2 are the currents in the two sheets, in absolute units.

By integrating first over one sheet and then over the other the repulsion on a sheet is found to be

$$4i_1i_2/b \tan^{-1}(b/s) - 2\ (i_1i_2s/b^2)\ \log_e\ (1 + b^2/s^2) \quad (4)$$

dynes per centimeter of sheet. The angle $\tan^{-1}b/s$ is to be expressed in radian measure. The curve for this expression, plotted on a base $(s-a)/(a+b)$, is the lowest curve of Fig. 1.

The repulsion between two solid straps is obtained by integrating expression (4) over the two sections shown in Fig. 3. It should be noted particularly that s is the distance between the centers of the straps and not the air space between the straps. If i_1 and i_2 are the currents in the straps, in absolute units, the force in dynes per centimeter of strap is



FIGS. 2 AND 3—REPULSION BETWEEN TWO THIN SHEETS, AND BETWEEN TWO RECTANGULAR CONDUCTORS

$$F = \frac{i_1i_2}{a^2b^2}\left\{2b\left[(s+a)^2 - (b^2/3)\right]\tan^{-1}\frac{b}{s+a} + 2b\left[(s-a)^2 - b^2/3\right]\tan^{-1}\frac{b}{s-a} - 4b\ (s^2 - b^2/3)\ \tan^{-1}\frac{b}{s} + (s+a)\left[b^2 - \frac{(s+a)^2}{3}\right]\log_e\left[\frac{(s+a)^2+b^2}{s^2}\right] + (s-a)\left[b^2 - \frac{(s-a)^2}{3}\right]\log_e\left[\frac{(s-a)^2+b^2}{s^2}\right] - 2s\ (b^2 - s^2/3)\ \log_e\left(\frac{s^2+b^2}{s^2}\right) + \frac{2}{3}(s+a)^3\log_e\left(\frac{s+a}{s}\right) + \frac{2}{3}(s-a)^3\log_e\left(\frac{s-a}{s}\right)\right\} \quad (5)$$

dynes per centimeter of one strap, where the dimensions are in centimeters and the angles are in radian measure.

As mentioned before, this formula is rather long, but if an approximation within a few per cent is all that is desired there does not seem to be any need to work

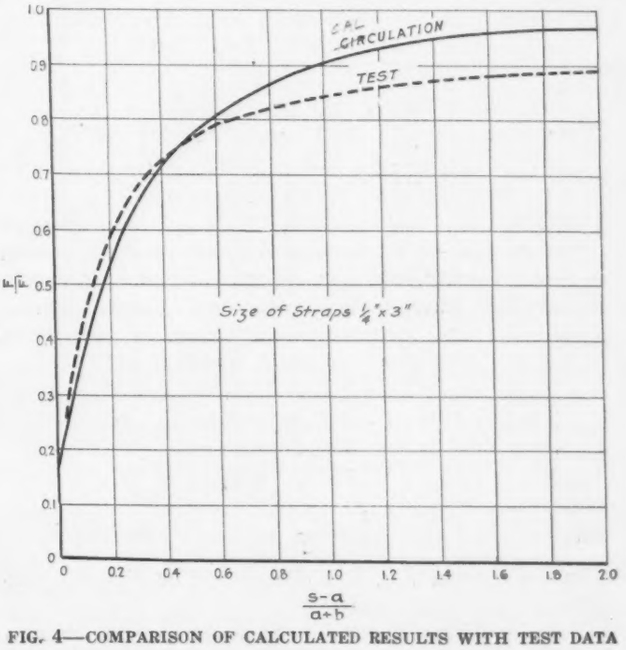


FIG. 4—COMPARISON OF CALCULATED RESULTS WITH TEST DATA

out formula (5), because Fig. 1 and formula (3) can be used instead for any case of equal long parallel rectangular conductors, and the only calculation needed will be simple slide-rule work. Fig. 1 can also be used for the repulsion between ventilated busbars consisting

of several straps with air spaces between them. For approximate results the complete busbar can be assumed to be the same as a solid conductor of the same outside dimensions. For theoretical exactness the repulsion of each strap in one busbar on each strap of the neighboring busbar can be calculated according to Fig. 1 or formula (3). Fig. 1 may prove useful in calculating the repulsion between coils in transformers.

The formula for the repulsion of two thin sheets in the same plane—that is, edge to edge—is

$$\frac{2i_1i_2}{a^2}\left[(s+a)\log_e\left(\frac{s+a}{s}\right)+(s-a)\log_e\left(\frac{s-a}{s}\right)\right] \quad (6)$$

This expression is used to calculate the upper curve of Fig. 1. The only approximation used in obtaining the formulas of this article is that skin effect is neglected and thus uniform current density is assumed over the section of the conductors.

The calculations in this article can be compared with a test curve which has been published in the *Transactions* of the American Institute of Electrical Engineers.[1] This test is a comparatively difficult one to make, currents up to 8000 amp. having been used. The results for one size of strap are shown in Fig. 4, together with the corresponding calculated curve.

Examples will now be given to show the use of Fig. 1 and formula (3). In three-phase work the forces due to the products of the instantaneous values of two alternating currents which are 120 deg. out of phase are treated the same as in calculating the alternating-current power, *i.e.*, by multiplying the instantaneous values of the alternating current and the alternating voltage.

Example I.—Find the repulsion of two straps measuring ¼ in. by 6 in. (6.4 mm. by 15.2 cm.), in parallel planes, with the distance between centers 1¼ in. (3.2 cm.) and with the current in each strap 5000 amp.

$$F' = \frac{5.40 \times 5000 \times 5000 \times 10^{-7}}{1.25}$$

$$= 10.8 \text{ lb. per foot, by formula (3).}$$

From Fig. 1, $F/F' = 0.42$ approximately, since

$$\frac{a}{b} = \frac{1}{24} \text{ and } \frac{s-a}{a+b} = \frac{1.25-0.25}{0.25+6} = \frac{1.0}{6.25} = 0.16.$$

Therefore, $F = 10.8 \times 0.42 = 4.5$ lb. per foot, average.

Example II.—Find the average force exerted between two straps measuring ¼ in. x 3 in. (6.4 mm. by 7.6 cm.), in parallel planes, with the distance between centers 6 in. (15.2 cm.) and with 10,000 amp. in each strap.

$$F' = \frac{5.40 \times 10{,}000 \times 10{,}000 \times 10^{-7}}{6}$$

$$= 9 \text{ lb. per foot, by formula (3).}$$

$$\frac{s-a}{a+b} = \frac{6-0.25}{0.25+3} = \frac{5.75}{3.25} = 1.77$$

and

$$\frac{a}{b} = \frac{1}{12}.$$

Therefore, from Fig. 1, $F/F' = 0.96$; or $F = 9 \times 0.96 = 8.6$ lb. per foot, average.

Example III.—Find the average mechanical force on three-phase busbars measuring ¼ in. x 3 in. (6.4 mm. by 7.6 cm.), in parallel planes, with an axial spacing of 6 in. (15.2 cm.) and with 10,000 amp. per phase.

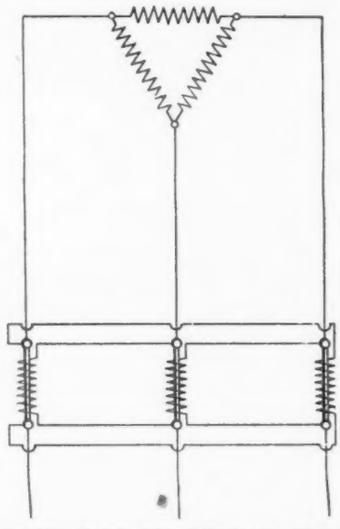
[1] See discussion by C. J. Barrow on "Mechanical Forces in Magnetic Fields," by C. P. Steinmetz, *Trans.* A. I. E. E., Feb. 15, 1911, page 392.

Let the three busbars in a row be called *A*, *B* and *C*. The currents in them are 120 deg. apart in phase. The force on *A* caused by $I_B = 9 \times 0.96 \times \cos 120$ deg. = 4.3 lb. per foot, average repulsion.

In calculating the repulsion on *A* caused by I_c $(s-a)/(a+b) = 3.61$ and F/F' may be assumed to be 1. Then $F = 4.5 \times \cos 120$ deg. = 2.2 lb. per foot. The total average force on $A = 4.3 + 2.2 = 6.5$ lb. per foot. The force on *C* is also 6.5 lb. per foot, which is approximately 75 per cent of the force in the similar single-phase circuit in Example II. The middle strap *B* is under repulsion from both *C* and *A*, and although it has a momentary force first in one direction and then in the other, the average force is zero.

Overload Circuit Opener

In patent No. 1,214,718 E. O. Schweitzer of Chicago proposes a system of fuses arranged so that if, for example, an overload current in one conductor of a three-phase circuit should operate or blow a fuse the other



WIRING ARRANGEMENT FOR OVERLOAD CIRCUIT OPENER

conductors of the system would not be receiving sufficient overload current to blow the fuses provided for their protection. The overload current in the first conductor, being permitted to persist to some extent, notwithstanding the blowing of the fuse, would in fact operate the fuses of the other conductors and thereby cut out the load on the line.

In each of the three conductors of the three-phase circuit are placed fuses which may be the ordinary type and adapted to operate or blow in the usual way upon an overload in the circuit conductors in which the fuses are respectively installed. Heating coils of resistance wire are wound about the several fuses. These heating coils are of sufficiently fine and high-resistance wire to generate heat that will melt or operate the fuses upon a predetermined overload current flowing in the coils. The heating coils are connected so as to receive currents from the circuits or conductors containing the fuses which the coils respectively include. If, then, an overload takes place in one conductor, the very drop across the fuse of the overloaded conductor provides the energy of the heating coil to melt the fuse of the neighboring conductor.

War Surcharge on Indianapolis Power Rates

Careful Analysis of Costs Made by the Indiana Public Service Commission to Support Its Important Action in Allowing Increase in Rates to Large Customers

IN THE important decision of the Indiana Public Service Commission giving authority to the Indianapolis central station companies to increase power rates, because of higher cost of coal and other materials and labor, many facts are revealed which sustain the judgment that larger revenue was necessary.

"The evidence reveals that both petitions rest primarily, but not solely," says the commission, "on failure to get coal on contracts and on resultant advances in the cost of coal, which constitutes at present prices, according to the Merchants' Heat & Light Company, 66 2/3 per cent, and of the Indianapolis Light & Heat Company, 70 per cent of the cost of kilowatt-hours at the switchboard."

Analyzing coal costs of the companies, the commission says in part:

Testimony by the Merchants' Heat & Light Company is that when the present schedules were authorized the prices of coal used by the petitioner were: Screenings, $0.75 per ton; mine run, $1.10 per ton. An audit by accountants on the staff of the commission reveals that this petitioner entered into a coal contract with the Jackson Hill Coal & Coke Company on Aug. 1, 1916, for two years for its entire requirements at the following prices, f.o.b. cars at mines: Screenings, $0.85 per net ton; mine run, $1.10 per net ton. The petitioner, notwithstanding this contract, has had to buy great quantities on the open market, at prices ranging from $2.95 to $4.25 per ton, f.o.b. mines, to fill deficits in its supply and to maintain services uninterrupted.

Testimony presented by the Merchants' Heat & Light Company is that, notwithstanding its contract, many times it has been compelled to go on the open market where "price for present and future delivery is what the traffic will bear"; that, notwithstanding the coal contract during the last year, it was billed coal at prices aggregating $123,000 in excess of the contract price; that even during the last two months, while working conditions were favorable, it unsuccessfully has tried to get the coal company to ship coal for storage purposes for use next winter, and that it faces winter without proper accumulations of coal.

This petitioner testified that it would have to estimate average cost of coal for the year ending June 30, 1918, at least at $2.50 per ton delivered at its plant. The consumption estimated for the year ending June 30, 1918, is 251,000 tons. The contract cost would be approximately $250,000 f.o.b. mines, or approximately $388,000 (on the basis of present freight rates) delivered at the petitioner's plant. Estimates for the year ending June 30, 1918, place the cost at $627,500 delivered at plant.

For the Merchants' Heat & Light Company the difference between the estimated cost for the year ending June 30, 1918, and the original contract price is $240,000. The original contract, however, was changed in April, 1917, 25 cents a ton being added to cover increase in mining wages.

The Indianapolis Light & Heat Company showed that on July 19, 1916, it had entered into a contract for its entire supply with the Queen Coal & Mining Company, Jasonville, Ind., for a period ending April 1, 1918, at the following prices f.o.b. mines: No. 5 screenings, $0.90 a ton; No. 5 mine run, $1.10 a ton; No. 4 screenings, $1 a ton; No. 4 mine run, $1.16 a ton. The contractor met all of the requirements until during December, January, February and March, when this petitioner was forced to buy 9033 tons on the open market at an average of $3.71 per ton f.o.b. its plant, and as high as $5.50, delivered at the plant, was paid. The petitioner showed that the coal has become inferior as to quality; that the petitioner granted, in April of this year, an addition of 25 cents a ton to the contract price to reimburse the mining company for advances to miners. The petitioner refused to grant another 25 cents asked by the company.

Testimony of the Indianapolis Light & Heat Company indicates that it does not anticipate that it will be able to get all of its coal requirements for the year ending June 30, 1918, on this contract; also that during the winter months it will be necessary for it to have an average of over ten carloads of coal a day; that at least coal in excess of ten carloads a day will have to be bought in the open market. The estimate presented in testimony by the petitioner for the year ending June 30, 1918, is as follows:

		F.O.B. Plant
100,000	tons on revised contract, with existing 55-cent freight rate, at $1.85	$185,000
19,000	tons during winter months to make up deficit beyond contract and also deficit caused by failure to ship ten cars a day, at $4	76,000
35,000	tons additional to cover period between expiration of coal contract March 31, 1918, and end of fiscal year on June 30, 1918, at $3	105,000
Amount	added by petitioner, estimate of 15 cents a ton additional freight rate on hypothesis that prayer of railroads for such addition will be granted by the commission of Indiana, to make intrastate rates conform with increase in interstate rates granted by Interstate Commission (154,000 tons at 15 cents)	22,950
		$388,950

LABOR

Testimony by the Merchants' Heat & Light Company is that common labor could be had when present rates and schedules were put into effect at 20 cents per hour; it cannot now be had at less than 27½ cents, and much of it is commanding 30 cents to 35 cents. Skilled labor could be had three years ago at 30 cents; it cannot now be had at less than 35 cents, and most of it commands 40 cents. All salaried men are receiving 10 per cent to 15 per cent more than three years ago. In the estimated operating expenses for the year ending June 30, 1918, common labor is at 37.3 per cent advance over the fiscal year ending June 30, 1915; skilled labor, 16.6 per cent; electricians, 5 per cent; salaries, 10 per cent.

The Indianapolis Light & Heat Company showed that increases in labor costs are estimated at 35 per cent for the year ended June 30, 1917, and 42 per cent for the year ending June 30, 1918, as compared, in both instances, with 1914-15. The following table presented by the petitioner shows a comparison made from its records for 1914 and 1917:

Kind of Labor	Per Cent Increase	Kind of Labor	Per Cent Increase
Switchboard operators	18.6	Coal and ash men	60.0
Water tenders	15.4	Steam fitters, pipe coverers, etc.	75.0
Electric repair men	14.3	Miscellaneous station labor	47.0
Firemen	25.0	Linemen	19.0
Oilers	18.0	Teams	25.0
Enginemen	18.0	Trouble men	52.0
Blacksmiths, machinists, carpenters, etc.	37.0	Common labor	33.3

TAXES

The Merchants' Heat & Light Company showed that the local tax rate when the present rate schedule was filed three years ago was $2.38; to-day it is $2.69, and under circumstances existing Aug. 8 $2.90 was estimated for the next year. The assessed valuation of the property for taxation was increased recently from $2,625,000 to $3,564,914, or to approximately 70 per cent of its alleged true cash value. If the assessment valuation stands and the tax rate be $2.90, the increase in local taxes would be from $32,723, when present rates were authorized, to $103,382. In addition, the city franchise tax and income tax will aggregate

$48,850, making $152,232 for taxes. The petitioner is apprehensive that there will be additional federal taxation.

The Indianapolis Light & Heat Company showed taxes: Year ended June 30, 1914, $88,083; June 30, 1915, $92,661; June 30, 1916, $84,682; June 30, 1917, $100,470; June 30, 1918 (estimated), $150,703. If anticipated war taxes were added the estimated total increase for 1918 over 1917 would be advanced to $59,530.

Other Materials

These two petitions rest primarily on increases in coal, labor and taxes. Testimony, however, showing increases in practically all other materials was presented.

The Indianapolis Light & Heat Company presented the following list of increases over prices prevailing in 1914:

Boiler and Stoker Parts	Per Cent Increase	Boiler and Stoker Parts	Per Cent Increase
Boiler tubes	87.0	Galvanized guy wire	98.0
Stoker parts	71.0	Cross-arms	7.0
Firebrick	15.5	Cross-arm braces (galv.)	81.0
Fireclay	77.0	Solder and tape	68.0
Brick for settings	14.0	Bolts and lags	55.0
Lubricants	46.0	Lightning arresters	36.7
Packing	11.0	Fuses	59.0
Wipers	60.0	Transformers	11.0
Steel and iron	154.0	Meters	11.0
Poles, chestnut	11.0	Cast-steel valves	70.0
Poles, cedar	13.0	Miscellaneous pipe and fittings	118.0
Insulators	23.0		
Copper wire	125.0	Stationery and printing	25.0

The Merchants' Heat & Light Company places the increased cost of copper at 188.8 per cent; of boiler tubes, 100.5 per cent to 100.8 per cent; stoker castings, 25 per cent; arc lamp globes, 147 per cent; gasoline, 1.09 per cent, as compared with the time present schedules were authorized.

Estimates submitted by the Merchants' Heat & Light Company for the fiscal year ending June 30, 1918, in which coal costs are based on $2.50 a ton delivered at the plant, show a deficit of $218,045 without allowance for depreciation or dividend.

Testimony and records show that the net income of the Indianapolis Light & Heat Company decreased so that during the six-month period ended June 30, 1917, there was a deficit of $224, and that it faces much heavier losses this winter and for the fiscal year ending June 30, 1918. For the fiscal year ending June 30, 1918, it estimates a deficit of $178,705, with no allowance for dividends.

Consideration of Pleas

There must be due allowance for possible redress on coal contracts with solvent, responsible mining companies, said contracts themselves being secured by bonds. There must, in light of the President's proclamation setting prices, issued since the hearing, be allowance on certain estimates, such, for example, as the estimate of $4 a ton on 19,000 tons of coal which the Indianapolis Light & Heat Company expected to buy on the open market during the winter, and possibly on the three-dollar estimate made on 35,000 tons of coal to complete the fiscal year. There must be allowance also in considering increased local taxes as applied to a specific period ending June 30, 1918, as only a part of such increases will have accrued by June 30, 1918.

On the other hand, coal supply may become so scant as to require curtailment of operation or service, which, while possibly working a saving in fuel costs, would not relieve the companies of fixed and heavy capital charges.

The commission is impressed with the weight of testimony, evidence and investigation bearing on cost of production. On the other hand, the petitioners have not shown material increases in cost of distribution.

The average cost per kilowatt-hour generated by the Merchants' Heat & Light Company was, for the year ended June 30, 1915, 5.74 mills; year ended June 30, 1916, 5.25 mills; year ended June 30, 1917, 6.80 mills; by the Indianapolis Light & Heat Company, for the year ended June 30, 1915, 5.91 mills; year ended June 30, 1916, 4.61 mills, and year ended June 30, 1917, 5.88 mills. The summary of kilowatt-hour production cost for the Indianapolis Light & Heat Company must be submitted to analysis. The 1915 figure of 5.91 mills is high and abnormal because of readjustments, while 5.58 mills average for the year ended June 30, 1917, is lower than costs now, because of the inclusion of normal production costs of July, August, September and October last year, when the average cost was approximately 4.50 mills, which may be taken as closely approximating normal production costs.

The commission has made investigation of electric light and power rates and it reveals that the Indianapolis rates provided for power users and for large consumers of electricity for light are very low. Testimony indicates that some existing lower power rates now are "absolutely lower than the cost of coal alone to-day."

The commission does not propose to shift from public utility companies all the burden incident to the war. It does not intend to be placed in the position of levying on patrons a tax to absolve coal companies or other contractors of their obligations, and the relief granted in no wise shall be taken as making good any losses that might be recoverable from contractors.

The Merchants' Heat & Light Company has instituted legal procedure against its coal contractor to recover $100,000 on excess price over contract prices, and an additional $23,000 of accumulated excess prices is to be settled on the basis of the final adjudication of the original suit.

Correspondence by the commission with operators of public utilities in England since the filing of the dissolved 30 per cent surcharge petition by the Indiana Electric Light Association indicates that the petitioners are not correctly advised as to war-time policies in England as affecting public utilities. This commission is informed that public utilities are not there regulated by prescribed "governmental agencies." Public utilities get their grants from Parliament, and most private company grants contain coal clauses under which changes are automatic as coal goes up or down in price and, generally, dividend rates are also affected. Under such coal clauses many or most rates have advanced, but, this commission is informed, not uniformly or as a determined war policy of governmental agencies.

The surcharge granted on electric services figures out a very small percentage advance on consumers who are on the higher schedule of rates. For those who have a 5-cent rate the increase is 10 per cent. For a 2½-cent rate the increase is 20 per cent, but on the large users of power for industrial purposes who are obtaining such power at very low rates the percentage increase will be heavier. These larger users, however, as a rule, are enjoying war-time profits or opportunities to "pass along such extra costs of manufacture." It is difficult to impose an unfair rate upon such patrons. They differ from the small users of electricity paying the higher rates in that whenever they see that the cost of power from the central power station is higher than what they consider reasonable they adopt other means of obtaining power. In this field the public utility is always in a competitive position.

Order of the Commission

It is therefore ordered that the prayer that a surcharge be authorized to be added to each bill be denied.

It is further ordered that as a measure of substantial justice between the company and its electric patrons there should be added a surcharge of 5 mills per kilowatt-hour to all bills rendered for power and for large lighting uses under rates or schedules printed or designated as standard rate "B," optional light rate "B-1," optional power rate "B-2," lighting and power rate "C," lighting and power rate "D," lighting and power rate "E," primary current rate "F," off-peak and power rate "G," commercial rate "H," additional wholesale power rate, flat power rate, and other commercial large light and power rates, and that said surcharge shall also be applied to municipal light and power.

No surcharge shall be added to bills for services rendered under the 7-cent rate carrying the 50-cent monthly minimum charge, or to bills for services rendered under suburban rates carrying higher rates and minimum charges.

The companies are authorized to put said surcharge into effect immediately, as of Sept. 1, 1917, to continue in effect on services rendered during the fiscal year ending June 30, 1918, unless modified or canceled by the commission.

The companies shall not consider this a change or modification of existing rates and schedules, but said surcharge shall be added as a separate item, so designated, to the total of bills rendered, under existing rates and schedules.

STATION AND OPERATING PRACTICE

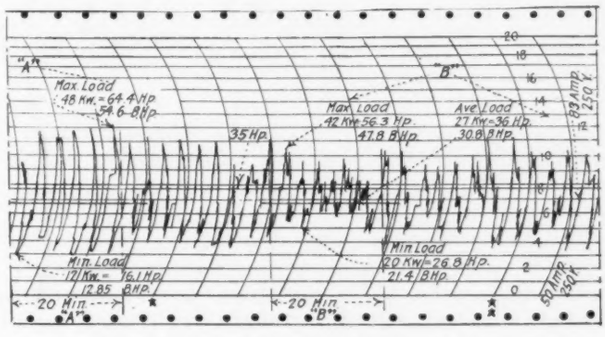
A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

MINIMIZING LOAD WITH GROUP GRINDER DRIVE

Adjusting Work Cycles so that They Overlap and Starting Grinders in Succession to Take Advantage of Flywheel Effect

BY SYDNEY FISHER

When selecting a motor to drive groups of grinding machines, care must be taken to see that the maximum capacity of the motor selected on an average power basis is greater than the sum of the loads imposed by all of the machines. The load imposed can be minimized by adjusting the work cycles so they overlap and by starting the grinders in succession to take advantage



LOAD CURVE WITH GRINDERS OPERATING UNDER DIFFERENT CONDITIONS

of their flywheel effects. The writer recently made an investigation along this line, the results being given here.

The drive consisted of twelve Hemming grinders, each machine having a cup-shaped emery wheel 16 in. (40.6 cm.) in diameter with a radial thickness of 1.25 in. (3.2 cm.) and operating at a speed of 625 r.p.m. The work feed is 1 ft. (30.5 cm.) per minute. Originally a 35-hp. motor was installed to drive six machines, but this motor was finally used to drive all twelve machines.

The machines are arranged in groups of six, each of which is operated by one man. The method of operation and the rate of feed is such that the power demand gradually increases to a maximum when all six machines are grinding simultaneously, and then gradually decreases to a minimum when the machines have finished grinding.

The two portions of the accompanying curve marked A and B indicate the variation in power demands under two different conditions of operation. During the period marked A the relative operation of the two groups is such as to cause their work cycles to be exactly in phase, while during period B they overlap. As shown by the curves, there is a marked difference in the power demand for the two conditions.

With loading A the average power is 30.8 hp., which is less than the rated output of the motor. The peak load is 54.6 hp., which is well within the maximum overload capacity of the motor. The minimum load is 12.85 hp. Evidently there is quite a variation in power demand.

The average power with B operation is 30.8 hp., the same as that for A, the work done in each case being practically the same and the periods equal (twenty minutes). The variation in power demand is considerably less and approaches the ideal condition of a uniform load of 30.8 hp.

With intelligent operation as exemplified in B excessive current variation is obviated and higher operating efficiency is obtained. Most important of all is the lessened possibility of interruption of service due to tripping of the overload relays with excessive overload.

ELIMINATING TROUBLES AFFECTING ARC LAMPS

How Periodic Burn-outs of Lamp Mechanism Coils Were Stopped by Altering Position of Shunt-Coil Stop and Changing Coil Insulation

The cost of maintaining arc lamps on one Southern system has been reduced considerably by making a few changes in the method of repairing the lamps. About fifty coils were formerly burned out each month, and some of the lamps could not be made to work perfectly after every possible adjustment had been tried. These lamps are of the series type, some flaming arcs and some ordinary arcs, and have an operating mechanism such as shown in the accompanying diagram.

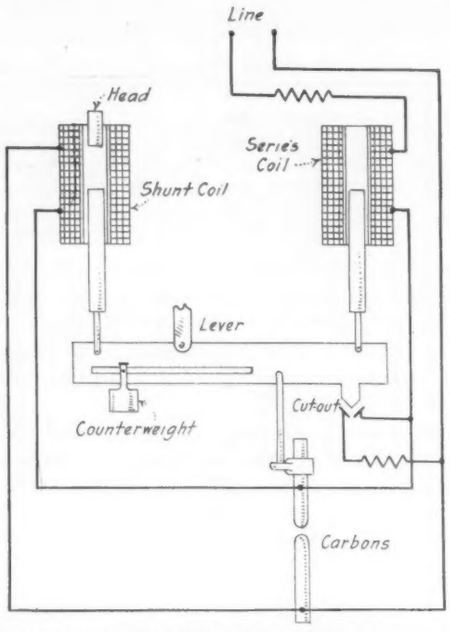
CONSTRUCTION AND CHARACTERISTICS OF ARC LAMP COILS

	Flaming Arc			Ordinary Arc	
	Shunt, Bad Coil	Shunt, Good Coil	Series	Shunt	Series
Diameter outside	2.3	2.3	2.5	2	2
Diameter inside	0.625	0.625	0.625	0.5	0.5
Length	5.0	5.0	5	2.5	2.5
Wire	19*	19*	12†	24†	12*
Layers	19	19	10	31	7
Resistance	6.4	6.4	0.395	44	0.21
Length of head inside coil	1.2	0.9	No head	0.25	No head
Length of armature inside coil when drawing ⅛-in. arc	2.5	2.8	2.8	1	2
Volts	70	70	....	70	....
Amp.	1.25	1.13	7.5	0.47	0.75
Ounce pull	13.0	10.4	22.5	5.2	14.2

*Double cotton-covered insulation.
†Single cotton-covered insulation.

To draw the arc to its correct length of 5/16 in. (0.80 cm.) the shunt armature must be lowered 1.3 in. (3.39 cm.). With the head set 1.2 in. (3.05 cm.) inside and the armature 1.3 in. (3.39 cm.) from the head, only 2.5 in. (6.35 cm.) of the armature is left inside of a 5-in. (12.7-cm.) coil. It was found by tests that the

pull exerted on the armature at this point was 13 oz. (0.36 kg.). However, with so great a pull the counterweight is not heavy enough even when placed at the extreme left of the lever. The head was then set only 0.9 in. (2.28 cm.) inside the coil and the armature



OPERATING MECHANISM FOR LAMPS WHICH WAS MODIFIED

extended 2.8 in. (7.11 cm.) inside when the arc was 5/16 in. (0.80 cm.) long. The pull was reduced then to 10.4 oz. (0 29 kg.) and the counterweight found sufficiently heavy to draw a 5/16-in. (0.80-cm.) arc. Besides, the current in the shunt coil was reduced from 1.25 amp. to 1.13 amp., thus reducing the heating.

After raising the coil heads a few of the lamps still operated imperfectly. It was found that this was due in some cases to having the wrong number of layers or using the wrong size of wire for the coils or the wrong thickness of insulation on the wire. Even though the number of layers in two coils is the same, if one has single cotton insulation and the other double cotton, then the current pull and resistance will be different. In the table are given the number of layers and the thickness of insulation that have been found most satisfactory. On account of giving better service the double cotton insulation is used where there is sufficient space on the spools to hold the necessary number of turns. If the space is too small the single cotton insulation is used. The size of wire on the coils and the kind of insulation are determined by inspection. To ascertain whether or not the coils have the proper number of layers, the resistance was measured, which is a fairly accurate check. After the heads were set properly and the right number of layers were put on, using wire of the right size and with the proper thickness of insulation, the lamps all operated perfectly.

When rewinding the coils two turns of 1/16-in. (16-mm.) asbestos paper were used for insulating the spindle in place of the mica sleeve used in the original winding. Formerly, after winding, the coils were painted with air-drying varnish, but this did not penetrate thoroughly and allowed the insulation to become charred, finally resulting in short-circuits between turns. This practice has therefore been changed and now the coils are dipped in liquid bakelite and then baked for five hours at a temperature of 70 deg. C. The bakelite penetrates to the bottom of the layers and gives very good protection against disintegration of the insulation caused by the action of heat.

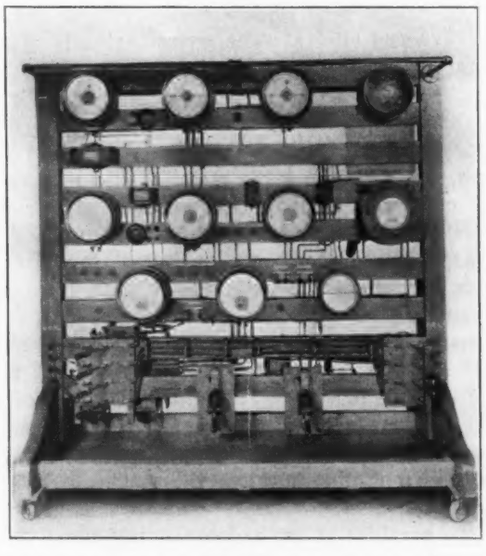
PORTABLE SWITCHBOARD USED IN UNIVERSITY LABORATORY

Designed to Help Students Study Central Station Problems—Eliminates Necessity of Assembling Portable Instruments

An experimental switchboard which has proved of great help to students at the University of Minnesota in studying central station problems, in addition to providing means for making experiments in connection with single-phase, two-phase and three-phase tests of motors, generators, transformers, controllers, etc., is shown herewith.

The switchboard is made of a skeleton wood frame mounted on 3-in. (7.6-cm.) rubber-tire, roller-bearing casters. The material is oiled red oak, which has been sandpapered and then given two coats of shellac. The equipment on the board includes a complete set of damped Westinghouse central station switchboard instruments and accessories, as follows: four current transformers, three potential transformers, one static ground detector, one alternating-current voltmeter, one frequency meter, one ammeter, one power-factor meter, one synchroscope, one polyphase wattless-factor meter, one indicating wattmeter, one direct-current voltmeter, one direct-current ammeter and two circuit breakers.

Switches are provided for the following purposes: Two for short-circuiting the secondaries of the current transformers, three for changing potential primaries, one for changing potential primaries from three-wire three-phase to four-wire two-phase, and an-



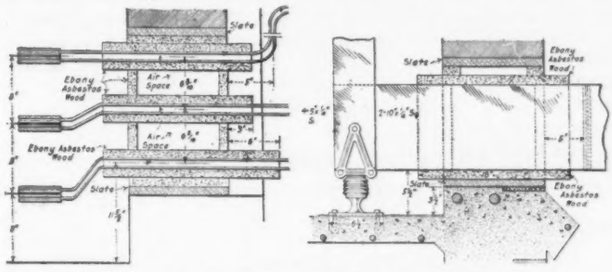
EXPERIMENTAL SWITCHBOARD FOR CLASS USE

other for short-circuiting the shunt terminals to the direct-current ammeter. A push-button is provided for the direct-current voltmeter, so that it remains ordinarily open-circuited. The board was designed by F. W. Spring, professor of electrical engineering at the University of Minnesota.

WALL ENTRANCE FOR USE WITH FLAT BUSBARS

Constructed to Prevent Admittance of Birds and Cold Air, but so that Bars May Be Well Insulated and Ventilated

To prevent birds and cold air entering its transformer room in the winter and yet give proper ventilation and insulation for outgoing busbars the arrangement shown herewith was used by a large cotton mill in



DETAILS OF BUS ENTRANCE TO TRANSFORMER ROOM

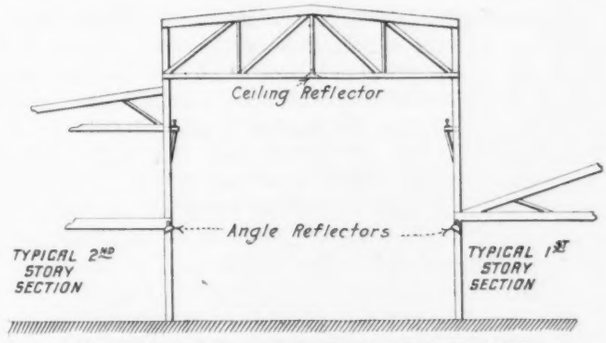
New England. Two 10-in. (25.4-cm.) by 0.25-in. (0.64-cm.) bars per leg are used in the secondary circuit where it runs through the wall, the spacing between phases being 6 3/16 in. (15.7 cm.). Ebony asbestos wood is used around each pair of bars with slate between the asbestos wood and the building walls. To secure the spacing mentioned asbestos slabs are inserted as shown. The pressure on the buses is 6600 volts.

LIGHTING CRANE AREAS

Use of Angle Reflectors to Deflect Light Rays Toward the Center of the Crane-Way

BY LEO DOLKART

The lighting of crane areas in machine shops and foundries often presents a difficult problem. On account of the necessary clearance for the crane, it is customary to install the lighting units close to the roof or even with the bottom of the trusses. Owing to the



CUSTOMARY AND SUGGESTED PLACING OF UNITS

height, either 750-watt or 1000-watt lamps are necessary. In nearly all cases it will be found that better results can be obtained by the use of angle reflectors when placed about 14 ft. to 15 ft. (4.3 m. to 4.6 m.) above the floor and between the columns and arranged to deflect light rays toward the center of the crane-way. This arrangement will not only cause better distribution, but will do so at an appreciable saving in energy.

The accompanying illustration shows the customary ceiling unit in dotted lines. The suggested units are shown in solid lines. On a floor plan these units would appear, of course, between the columns. This suggested method of lighting will be found very adaptable to ordnance buildings, where the rifling machinery is generally placed in the crane area and very close to the columns. It will be found that porcelain-enameled reflectors will give better results and at the same time will require less cleaning. Tests show that the width of the area as well as the height of the unit will determine the shape of the angle reflector best adapted for each individual case. Care must be exercised in designing such a lighting system so that no dark areas result along the floor on the center line of the building.

DISTRIBUTION OF CURRENT IN PARALLEL FEEDERS

Simple Method of Determining the Manner in Which Several Circuits Will Share a Load When New Feeders Are Placed in Parallel with Them

BY V. KARAPETOFF

Following is a simple method by which the distribution of alternating current in parallel feeders may be predetermined before laying additional circuits.

Let the resistances of the feeders be $r_1, r_2 \ldots r_n$, and their reactances $x_1, x_2 \ldots x_n$, and compute the following quantities for each feeder: Impedance, $z = \sqrt{r^2 + x^2}$; admittance, $y = 1/z$; conductance, $g = r/z^2$; susceptance, $b = x/z^2$. When underground cables and overhead lines are in parallel, some of the reactances and susceptances may be negative, according to whether the capacity reactance or the inductive reactance predominates. For the purposes of this problem either one may be assumed to be negative. The equivalent admittance of all the feeders is:

$$Y = \sqrt{(\Sigma g)^2 + (\Sigma b)^2}.$$

The percentages of the total current carried by the individual feeders are as follows: $y_1/Y, y_2/Y, \ldots y_n/Y$. The arithmetical sum of the individual currents is greater than the total current because, generally speaking, they are out of phase with one another.

To illustrate the application of this method, assume an overhead line 1 connected in parallel with an underground cable 2, and let their characteristics, in ohms and mhos per phase, be as follows:

$$r_1 = 0.2; \quad r_2 = 0.07;$$
$$x_1 = 0.3; \quad x_2 = -0.5.$$

Then $z_1 = \sqrt{0.04 + 0.09} = 0.36$; $z_2 = \sqrt{0.0049 + 0.25} = 0.505$,

$$y_1 = 2.78; \quad y_2 = 1.98;$$
$$g_1 = 1.54; \quad g_2 = 0.275;$$
$$b_1 = 2.31; \quad b_2 = -1.96.$$

From which $Y = \sqrt{(1.54 + 0.275)^2 + (2.31 - 1.96)^2} = 1.85$. Therefore the overhead line carries 2.78/1.85 = 150 per cent of the total current, and the cable carries 1.98/1.85 = 107 per cent.

The conditions selected are extreme in that there is considerable current resonance between the overhead line and the cable. With two overhead lines or with two cables in parallel the division of the load is much more uniform.*

*For proofs and details see Karapetoff's book on "Electric Circuit."

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

COMPANY EXTENDS INTERVAL OF RETURN LAMP RENEWALS

Study of Operating Conditions Shows that Less than 20 Per Cent of Lamp Service Customers Ask for Renewals Periodically

The United Electric Light & Power Company, New York City, has made a careful study of the operating conditions in its lamp department which shows that less than 20 per cent of the lamp service customers ask for renewals when calls are periodically made by the lamp wagons.

In view of this fact, the company has extended the interval between such periodic calls upon lamp service customers from three months to four months. This, however, did not involve any change in the policy of furnishing renewals upon special request.

VALUE OF DEMONSTRATORS IN ELECTRIC RANGE SALE

Woman Employed in This Capacity by California Company Outlines Attitude of Women Customers Toward Her

Light is thrown on the question of the value of a woman demonstrator in connection with introducing the electric range into homes and keeping the ranges sold by testimony from the Southern California Edison Company, which employs a woman demonstrator to look after the customer after the range has been installed and see that she obtains the best results from electric cooking.

In a paper recently presented before the employees of the company, Miss Ebert, the demonstrator, told of the attitude of women customers toward her and her work as follows:

The demonstrator calls at the homes as soon as possible after the ranges have been installed and explains their operation. If the customer cares to have a demonstration, which is the most practical means of instruction, it is arranged for. Sometimes it consists of the cooking of a meal to show the most economical method of operation, and at other times a baking or broiling operation is all that is desired. Although there are some who hesitate to have a demonstration at first for fear their kitchen is not so modern as their neighbors' or some other trifling reason, they can be persuaded to allow you to help them. The demonstrator carries a cooking outfit with her and can supply any utensils needed. Some of the most pleased customers are people of this kind. They are always glad to have you call when returning to the district.

I am reminded of three women in one neighborhood two of whom had not desired a demonstrator and had had trouble in cake baking. The third woman, a Mrs. Crowe, had had a demonstration and was so delighted that she crowed to the other two until they were willing to have a demonstration and now they are satisfied with their ranges.

There is another attitude which a woman occasionally takes that is very amusing. She thinks the demonstrator is sent out to teach her to cook and is quite indignant to think she should be taught to cook after years of experience. However, she soon forgets herself and realizes that she is not being instructed in cooking but in the operation of her electric range.

COMBINATION POWER RATE FOR LIMITED-HOUR SERVICE

New Jersey Small-Town Property Rate Applicable to All Services Not Requiring Energy Between Dusk and 10.30 p. m.

The Commonwealth Water & Light Company of Summit, a New Jersey town of 7500 inhabitants, has in operation a combination power rate for limited-hour service that is applicable to all services that do not require energy between dusk and 10.30 p. m.

The charge consists of two parts, namely, a service and an energy charge. The service charge per kilowatt or horsepower per month is as follows for the maximum kilowatt or horsepower demands specified:

One or less, $1.50; 1.5, $1.25; 2 to 4, $1; 5 to 7, $0.95; 8 to 9, $0.90; 10 to 14, $0.85; 15 to 19, $0.80; 20 and over, $0.75.

The energy charge is 2 cents per kilowatt-hour and is additional to the service charge.

These prices are net if paid on or before the tenth day after the mailing of the bill from the post office at Summit, and a penalty of 5 per cent is added thereto in case of non-payment on or before the said date. The demand is determined by taking the full rating of the apparatus connected unless three or more motors are installed on the same meter. When three or four motors are installed the demand for the motors is taken as being 80 per cent of the total rating of all the motors, and for more than four motors 75 per cent, provided that the rating thus obtained shall not be less than would be obtained by omitting any one or more of the said motors. When the connected load exceeds 20 hp. the demand may be determined from the readings of a maximum-demand registering instrument. When a double-throw service switch is installed, so that the maximum possible demand is limited to that part connected to one side of switch, the demand is based upon that part only.

The company will not furnish two-phase service for an installation of less than 5 hp., and for 5 hp. or more only within a limited territory. Service is furnished for motors of undesirable starting characteristics, and customers are advised to consult with the company before purchasing motors. All apparatus served under this rate has to be disconnected at dusk and not again connected before 10.30 p. m.

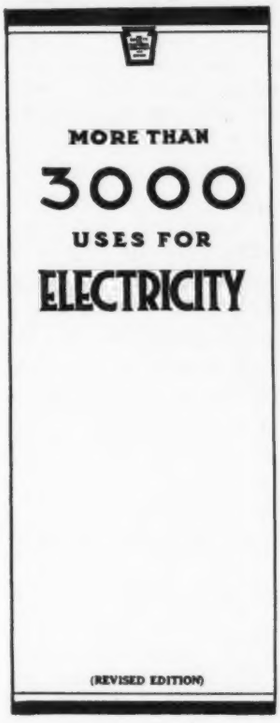
Twenty-four-hour service for other than lighting purposes may be had on the "limited-hour" schedule by considering each device to be so served as having four times its rated capacity.

SIDE GUIDE & GRIPPER

LIST OF APPLIANCES AND THEIR PURPOSES

Society for Electrical Development Revises First Edition, Giving 3000 Instances Where Electricity May Profitably Be Used

Although its first edition of a list of more than 3000 instances where electricity may profitably be used in the factory, store, home, mine, in transportation and on the farm, has been out but a few months, the Society for Electrical Development has already issued a revised list.



The purpose of the publication of the list is to help systematize effort on the part of electrical salesmen, to save time and to provide an easier, better means for getting more business in each of the above classes. It is to give systematic suggestions as to how the public might use electricity to help their work—with profit to buyer and seller.

The demand for the first edition was greater than the supply, and the new edition will provide for those who were unable to receive copies of the first edition as well as meet the new demand sure to arise in the immediate future for a book of this unusually comprehensive description.

CENTRAL STATION COMPANIES AS ADVISERS ON LIGHTING

Inadequate Illumination of Factories Indicates Manufacturers' Need of Technical Advice—Publicity for Consulting Service

BY R. W. ASHLEY

Illuminating Engineer Milwaukee Electric Railway & Light Company

Few central station companies seem to realize how much is to be gained by making an effort to co-operate with their customers in improving the lighting conditions. The revenue to be gained is not the only thing to be considered in caring for industrial lighting business. Most persons expect the central station company to advise them on power and lighting, and the demand for industrial lighting created by factory lighting legislation and conditions brought about by the war makes it almost imperative that central station companies provide one or more engineers to assist the manufacturing customers.

Manufacturers when they are about to improve their lighting installations want some one to advise them who represents a company which will insure them that the improvements will be in accordance with the requirements of the state code and who is not prejudiced against or partial to the equipment of any particular company. If they know that the central station company has men for this purpose they will usually look to it for advice. This is indicated by data published in the National Electric Light Association reports, which show the amount of industrial work being done by the illuminating engineering division of the Commonwealth Edison Company of Chicago. This company, however, continually advertises its illuminating engineering division so that the customers will always know that they have such service at their disposal. The advertising is of such a nature that it also gives the customer an idea of the numerous things which the engineer is able to do for him.

FIG. 1—GENERAL ILLUMINATION FOR SHOE FACTORY

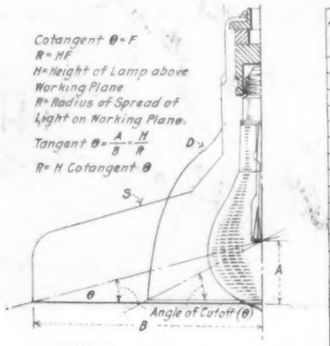
The accompanying photographs were taken in one of the many types of factories for which a central station company is called upon to plan the illumination. They were obtained at night and show the system of illumination which the illuminating engineer of the Milwaukee Electric Railway & Light Company was called upon to plan. This is one of the first shoe factories to be illuminated throughout by general lighting.

FIG. 2—EVEN ILLUMINATION AT WORKING TABLES

In order that the foremen of the factory might be assured that a system of general lighting could be

designed which would give the best results, the lighting in one of the rooms was installed and tried out before the work was started in the remainder of the factory. The system is now complete and giving excellent satisfaction.

Curves and sketches like those shown herewith were used in helping the customer select a practical fixture which would give a wide spread of light on the working place and at the same time protect the eyes of the workmen from the glare of exposed lamps. The same sketches are also useful in determining the hanging height and spacing of the fixtures. The central station man handling such work is always in position to get



ANGLE OF CUT OFF θ	COTANGENT F	ANGLE OF CUTOFF θ	COTANGENT F
5°	11.43	24°	2.25
6°	9.51	25	2.15
7°	8.14	26	2.05
8°	7.12	27	1.96
9°	6.31	28	1.88
10	5.61	29	1.80
11	5.14	30	1.75
12	4.70	31	1.66
13	4.33	32	1.60
14	4.01	33	1.54
15	3.73	34	1.48
16	3.49	35	1.43
17	3.27	36	1.38
18	3.08	37	1.33
19	2.90	38	1.28
20	2.75	39	1.23
21	2.60	40	1.19
22	2.47	41	1.15
23	2.36	42	1.11

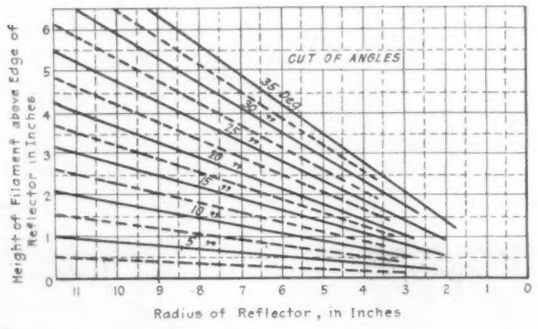


FIG. 3—GENERAL FIXTURE DATA

curves, data and photographs so that he can not only propose an installation that is right but can show the customer why it is right.

Results of Investigation in Chicago

Last year the writer of this article had occasion to visit 229 factories in Chicago and inspect the lighting conditions. The factories were in a district which had at the time received no special attention. The following shows a summary of the kind of lighting installations in use:

Electric:	
Drop lights (only)	103
Drop lights and general lighting	32
General lighting only	20
Gas and electric	23
Gas:	
Gas arcs	38
Gas arcs and open-flame	2
Open-flame (only)	3
No lighting	8
Total	229

Out of the 229 factories, only forty-eight had lighting installations which could be considered adequate. Twenty-nine, or more than 50 per cent of these, were the result of work done by the illuminating engineering division of the central station company. Only three of the factories had men in them who knew anything about the principles of good factory lighting. Present records of the Chicago company show that as a result of the work done by the illuminating engineering division many of these factories are now improving their systems of illumination.

Judging from other data which have been collected, it is safe to assume that the foregoing summary is a fair representation of conditions throughout the country. In the near future, however, since many of the state laws demand good lighting and the demands on factories are increasing every day, the changes to systems of good illumination are going to be greatly accelerated. The manufacturers must have some one to give them advice which is in accordance with good usage of illumination and the state code. It is reasonable to expect that many of them will look to the central station company for aid. Each company should have a competent man ready to care for this work, for the manner in which such requests are handled has a reflex action upon the company either for good or for bad that should never be forgotten.

COMMERCIAL DEPARTMENT WAR-TIME ECONOMIES

Changes in Method of Billing and Meter Reading and Other Evidences of Effort to Keep Down Labor Expense

Not only is the operating department to be considered in effecting war-time economies, but also the commercial departments come in for their expense pruning. It is now well recognized that expenses of every character must be carefully watched and unusual methods taken to reduce them where possible.

In the commercial department labor expense is the principal item that can be lowered. In a number of companies it will be found to be a case of getting along with the help left, for the army and navy have taken many men.

Combination companies have in many cases instituted a plan of having meter readers read both the gas and the electric meters and having the customer billed for both services on one bill. Aside from the saving in postage, 4 cents per account where receipt is mailed, and in stationery, there is a saving in the number of employees necessary, so that the expense per bill is cut considerably.

The practice of billing bi-monthly or tri-monthly is receiving more attention than ever before. One Middle Western company is using the bi-monthly plan with a reduced force by billing certain customers one month and the others the next. An even load is thus kept on the clerical force and the billing expense is almost cut in two.

Other economies, particularly in the direction of greater efficiency, are being instituted in matters of bookkeeping, filing, form letters, ways of billing, addressing, etc.

The reduction of delinquent accounts is also assuming more importance. Managers are paying more attention to their form letters and to their method of contact with customers.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Estimating Direct-Current Machine Costs.—When no actual recent cost is available of an exactly identical machine, the estimating of a new size of generator or motor may entail a considerable expenditure of time, and often the costs that are at hand are not in sufficient detail to lend themselves conveniently to manipulation or admit of very close adjustments or pro ratas being made. A handy pro rata rule for obtaining the approximate cost of a new machine, given the cost totals for labor and materials of the basic machine and dimensions of the armature core of the latter and of the one to be estimated, follows: Cost of labor $= \sqrt{d^2} \times k_l$, cost of material $= \sqrt{l} \times d^2 \times k_m$, where d = diameter of core (external) in inches, l = length of core (between end plates) in inches, and k_l and k_m = constants (cost $\div \sqrt{d^2}$) and (cost $\div \sqrt{l} \times d^2$) for labor and material. These will vary according to the particular maker.—London *Elec. Review*, Aug. 17, 1917.

Generation, Transmission and Distribution

Formulas for Calculating the Heat Carried to Waste by the Flue Gases.—E. A. UEHLING.—The author derives a number of simple formulas for determining the heat carried away from furnaces by dry gases, incomplete combustion, water vapor in air, combustion of hydrogen, and moisture and water of hydration in fuel. In addition, equations are given for calculating the theoretical maximum CO_2 obtainable from fuel containing hydrogen, the percentage of excess air supplied, and the percentage of oxygen in the flue gas.—*Bulletin of Stevens Institute of Technology*, April, 1917.

Construction and Operation of Boilers for Intensive Service.—F. MÜNZINGER.—The author of this paper considers modern boiler practice from the standpoint of cheapness obtained by better utilization of constructional materials and higher stressing of the finished equipment. The influence of turbine development on boiler practice has been far-reaching. The possibility of concentrating very high power in single, compact units led to the development of two-story boiler houses. Large overhead bunkers gave way to small pockets directly the coal-handling plant became sufficiently reliable, thus eliminating much heavy ironwork and saving greatly on the size and cost of buildings. By using comparatively small and cheap feed heaters it became possible to add to over-all efficiency while cutting away that portion of the boiler which would otherwise extract heat from the cooled flue gases.—*Science Abstracts*, Section B, May, 1917. (Abstracted from *Zeits. Vereines Deutsch Ing.*, Nov. 11 and 18, Dec. 2 and 9, 1916.)

Electrification of the Riksgrans Railway.—First part of an article describing the Porjus generating plant, which is situated about 164 ft. (50 m.) underground. Space has been provided in the machinery hall for five turbines, of which four have been installed, two being connected to single-phase generators for railway service, one to a three-phase generator and one to a spare set consisting of a three-phase generator and a single-phase generator connected together. Each turbine is rated at 12,500 hp. Later it is hoped to enlarge the machinery hall to make room for five additional sets. The machines are compounded according to the Danielson system; *i.e.*, the compounding converter is connected to the field winding of the exciter and not to the alternator field. In this way both the compounding transformer and the converter are reduced in size, and it is easier to secure good commutation in the latter. Each generator with its transformer forms an inseparable unit, and the circuit can be opened first on the high-tension side of the transformer, where the generators are also synchronized. Pin insulators designed for 80,000 volts and having a height of 600 mm. (23.6 in.) are used on the transmission system. A couple of flanges are placed immediately below the top support for the conductors, but otherwise the insulators are smooth. Both the top and bottom supports are secured by means of clamps. The high-voltage relays consist of a motor magnet, the movement of the armature being translated to the contact device by a vertical shaft of non-conducting material in the center of the insulator.—London *Electrician*, Aug. 17, 1917.

Fuel Oil and Specifications for Purchase.—ROBERT SIBLEY and CHARLES H. DELANY.—Discussion of the fundamental characteristics of fuel oil, taking into account its physical and chemical qualities. Eleven important points which should be taken into consideration when purchasing fuel oil for power generation purposes are dwelt upon.—*Journal of Electricity*, Sept. 1, 1917.

Installations, Systems and Appliances

Electricity in Madagascar.—An account of how French enterprise has established an electric system in Tananarive, Madagascar, which is satisfactorily providing motor and lighting service in that far-away colony. In 1915 there were 853,645 m. (about 1873 miles) of high-tension and 650,769 m. (about 1046 miles) of low-tension lines (network and transmission) supplying energy to more than 22,000 customers. About 224,000 lamps and 2922 motors were connected to the lines, the motors being rated at a total of 23,188 hp. The article describes the equipment, power house, substations and transmission lines.—*Revue Gén. de l'Elec.*, July 28, 1917.

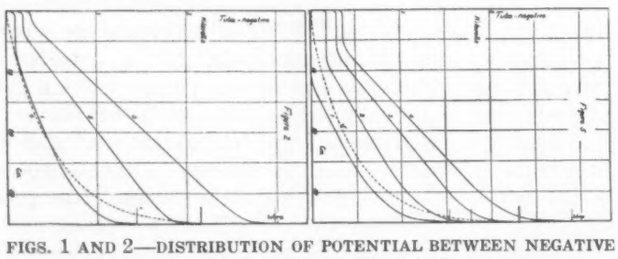
Open and Inclosed Type Fuses.—A. B. EASON.—This article deals with the question of fusing currents in open and inclosed fuses rated at 3 amp. to 100 amp. at 250 volts and 500 volts and 60 amp. to 1000 amp. at 22 volts and 40 volts, the latter being used in telephone exchange work. The open-type fuse considered in this article is one in which the fuse wire is bare and is stretched between two terminals. Along the greater portion of its length it is not in contact with any solid

body. The inclosed fuse considered is one in which the fuse wire is placed in a fiber tube, the space between the tube and the wire being filled with some form of fire-resisting insulating material of a non-hygroscopic nature. The discussion of fusing currents does not cover the semi-inclosed fuses, as it deals with two clearly defined types where the conditions of the wire are supposed to be definitely known; but it includes the case of porcelain handle fuses which hold a bare wire. The various characteristics, advantageous and disadvantageous of these two types of fuse, are summarized in this article.—*Post Office Electrical Eng. Journal*, July, 1917.

Electrophysics and Magnetism

Industrial Lifting Magnets.—J. VICHNIAK.—The lifting magnet is particularly useful for material not easily shackled, such as chips from machine tools, various structural discarded odds and ends, and also for material of regular shape of moderate weight. One unique application is in handling hot billets. These pieces, difficult to attach to the ordinary crane hook when hot, are readily raised and removed by the magnet. Special water-cooled magnets are employed for this service. To increase the capacity when lifting irregular pieces, the Couffinal works at Saint-Etienne have designed a magnet with subdivided vertically movable pole faces. These subdivided faces, by their vertical movement, conform to the irregularities of the pieces lifted and prevent lateral motion as well as increase the lifting capacity. Another special form of magnet for lifting a bundle of rods or other long pieces is provided with a linkage, somewhat after the manner of a clamshell dredge bucket, operating arms that embrace the load held by the magnet. Once in place, the magnet is de-energized and the load is transferred to the arms, thus economizing current.—*Le Genie Civil*, April 21, 1917.

Distribution of Potential in a Corona Tube.—HARRY T. BOOTH.—The distribution of potential between the electrodes of a corona tube was determined for four sizes of wire, for various pressures and potential differences. From these curves the density of the charge along the radius was derived by means of graphical methods. In general the space between the anode and the cathode may be broken up into four regions: (1)



FIGS. 1 AND 2—DISTRIBUTION OF POTENTIAL BETWEEN NEGATIVE TUBE AND FOUR SIZES OF WIRE ALONG AXIS

A region immediately surrounding the wire, which is characterized by a very large potential gradient. This may be due to the excess of the number of ions or electrons approaching the electrode over the number of those leaving, since the former number includes ions generated at all parts of the field, whereas the latter contain only ions that are generated in the narrow layer close to the wire. Thus, the charges on the excess of negative ions near the wire disturb the electric field so that the potential difference per centimeter, or the gradient, is large near the surface of the wire. (2) A region of approximately constant force extending from the "surface layer" region adjacent to the wire to a point which varies with the pressure, current and voltage. At the higher voltages the actual potential at a given point in this region is greater than the theoretical electrostatic potential, and the tangent to the curve may be either greater or less. Figs. 1 and 2 show the electrostatic curve (dotted), in comparison with actual curves taken. (3) A region of little or no force near the tube. In passing from the second to the third region the number of positive ions increases (since they are generated in all the space between the wire and the third region), and their charges oppose those on the negative ions to such a degree that not only the negative charges on the ions but also the electrostatic forces due to the configuration of the system are neutralized. (4) A region close to the tube, corresponding to the "surface layer" contiguous to the wire. In this space positive charges accumulated at all the remaining parts of the radial field are predominant, and there is an abrupt cathode drop at the surface of the tube. When the wire is negative and corona appears, a potential curve is obtained which differs somewhat from the positive curves. Large cathode and anode drops appear, and the intervening space has a very small field.—*Phys. Review*, September, 1917.

Electrochemistry and Batteries

The Storage Battery.—L. JUMAU.—First part of an article on the actual state of the storage-battery industry. In this installment the author discusses critically the theory recently put forth upon the functioning of the positive electrode by M. Féry, who holds that when charged this electrode becomes composed of an oxide Pb_2O_5 and that on discharge it is reconverted to PbO_2. The author opposes to these conclusions the results personally obtained in a great number of analyses and experiments which tend to confirm the view that the positive electrode becomes self-sulphated according to the theory of double sulphating.—*Revue Gén. de l'Elec.*, Aug. 4, 1917.

Units, Measurements and Instruments

Demagnetization of Iron.—ARTHUR WHITMORE SMITH.—The proper magnetization curve for a given sample of iron is not obtained unless the iron has been completely demagnetized. Reversals of the magnetizing current at the rate of once a second may be too rapid for effective demagnetization. When preparing to demagnetize a ring of iron or other magnetic circuit the time required for the magnetic flux to become fully reversed should be determined. This is reaily done by closing the galvanometer key after the reversal of the magnetizing current and noting what interval, t, is necessary in order that there shall be no deflection. For complete demagnetization the current should not be reversed faster than once in $2t$ seconds. This interval is not constant even for the same ring, but is longer in the region of greater permeability. In this region, therefore, the current should be reversed more slowly than at higher magnetizations. In every case the reversals should be slow enough to allow the flux to reach its full value before the next reversal. This rule allows faster reversals at the higher magnetizations.—*Phys. Review*, September, 1917.

Alternating-Current Bridge Method of Comparing Two Fixed Inductances at Commercial Frequencies.—T. PARNELL.—The simple Maxwell inductance bridge cannot be used conveniently for the comparison of fixed inductances on account of the tedious double balance necessary. By making use of a current detector whose deflections depend on the component of the current in quadrature with the emf. applied to the bridge it is, however, possible to make the condition for no deflection depend either chiefly on the inductances or chiefly on the

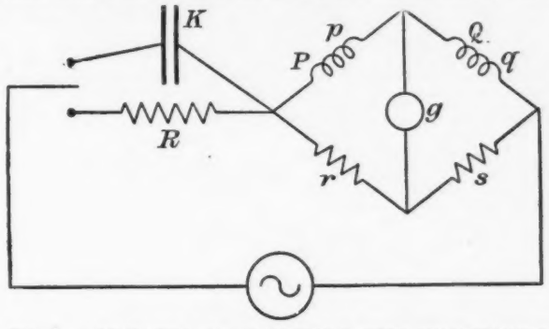


FIG. 3—APPARATUS FOR COMPARING FIXED INDUCTANCES

resistances. The arrangement of the bridge is shown in Fig. 3. With R in circuit, s is adjusted for no deflection; this gives an approximate balance for the inductances. Then, with K in circuit, q is adjusted for no deflection; this gives an approximate balance for the resistances. The process is repeated, and after a few balances values of s and q are obtained that give a balance with either R or K in circuit, in which case the bridge is completely balanced, and $P/Q = p/q = r/s$. In this way an unknown inductance can be balanced against a standard to one part in a few thousand in a few minutes.—London *Electrician*, Aug. 17, 1917.

High-Temperature Measurements with the Optical Pyrometer.—W. E. FORSYTHE.—Various methods employed in the measurement of very high temperatures are discussed, and the practical utility of one of these methods is illustrated by results secured through relatively unskilled observers.—*Gen. Elec. Review*, September, 1917.

Instruments for Electric Measurement.—H. ARMAGNET.—A historical and critical article dealing with both laboratory and industrial measuring apparatus, with indications upon the choice of instruments according to their object and the conditions of their use. In the category of laboratory apparatus, developments in the galvanometer, the manganin resistor, the cadmium standard of electromotive force, condensers of various degrees of exactitude, and series aerial condensers for wireless telegraphy are touched upon. Under the head of industrial apparatus, magnetic galvanometers, thermal, electromagnetic, electrodynamic, electrostatic and induction instruments are dealt with.—*Revue Gén. de l'Elec.*, July 28, 1917.

Telegraphy, Telephony and Signals

Internal Relations in Audion-Type Radio Receivers.—RALPH BOWN.—Experimental curves are shown from which the details of the operation of the audion as a detector in radio-telegraphy are followed. A theory of the action of the gas in the bulb is presented which explains the curves and is in agreement with all the observations. Some of the peculiar features of operation as influenced by the nature and pressure of the gas, magnetic fields, the circuits employed, etc., are discussed in their relation to the theory and the experimental data.—*Phys. Review*, September, 1917.

Miscellaneous

Electrical Conduction in Metals at Low Temperatures.—FRANCIS B. SILSBEE.—It is pointed out that the phenomenon of critical current is a necessary consequence of the existence of a critical value of magnetic field. The relation between the two is that the critical value of the current is that at which the magnetic field due to the current itself is equal to the critical magnetic field. On account of the great experimental difficulties connected with work in this range of temperature, the quantitative data available for testing this relation are rather scanty as yet, but the data which are available are in satisfactory agreement with the theory.—*Scientific Paper* No. 207, U. S. Bureau of Standards.

Book Review

PRINCIPLES AND PRACTICE OF ELECTRICAL ENGINEERING. By Alexander Gray. New York: McGraw-Hill Book Company, Inc. 432 pages, illus. Price, $3.

This second edition of Professor Gray's excellent work is obviously and necessarily an outline, a sound basis for extension by the skillful teacher. One cannot make a treatise on the principles and practice of electrical engineering in any sense complete or satisfactory in detail in the compass of 400 pages, but one can do precisely what Professor Gray has successfully accomplished in setting out an outline of the principal phases of the subject and the chief apparatus necessary for the student to comprehend in such form as to be of great use to the teacher and a valuable guide to the learner through a series of lectures considerably amplified beyond actual matter given in the textbook. With this understanding of its necessary limitations, Professor Gray's book is a most useful one, the more valuable on account of a large group of well-selected problems admirably adapted to enforce the fundamental computations of the text. From this standpoint rather than by the details omitted or under-emphasized should the book be judged, and a judgment so formed is distinctly favorable. The volume is enriched by a particularly good and useful set of illustrations covering a very much wider range and of much more modern and practical character than those usually to be found in textbooks. In another edition the insertion of a carefully selected bibliography at the end of each chapter, pointing out to the student the main sources of detailed and first-hand information, would prove a valuable addition appreciated not only by those who are learning but by those who are teaching. Much of the valuable information on practical matters in electrical engineering is scattered in a way most embarrassing to one who attempts to inform himself from original sources, and these cannot be too often or too pointedly mentioned. All in all, the volume contains a very large amount of well selected and generally accurate information covering an unusually wide range of matters. Its virtues are obvious, and its one noticeable failing is that almost inseparable from so condensed a treatise, the tendency to occasional generalizations.

Scientific and Industrial Research

A Department Devoted to Interchange of Ideas, Investigations Contemplated, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF

Cornell University, Ithaca, N. Y.

FORESIGHT IN RESEARCH WORK

Some Conditions that Are Hindering or Discouraging Research and Suggestions for Their Improvement

BY W. W. STRONG

Advanced thinking and work for the welfare of a people are notoriously ill paid. These efforts may receive wide publicity and the benedictions of all thinking people, but not their money. Research work which is of this type is an absolute necessity if a nation is to be a leader in the modern world, yet the amount we do as a people compared with what we might do and ought to do is incredibly small.

Why does this condition exist? One reason is the lack of appreciation by the public. Furthermore, a very large part of our research workers are dependent upon patrons. Worthy as such patrons are, the method of endowing research should be one of the minor ways of maintaining it.

Moreover, society has failed to give place and influence to the research worker. It has thought it sufficient to give to the investigator a medal or a fellowship in some society years after his work has proved to be successful. Leaders in engineering and scientific advancement have practically no representation in the governing bodies of our cities, counties, corporations, states, or in the nation. Even universities are controlled by business men.

If tariffs and subsidies are necessary for infant industries, then wise aid is required for research work. Our patent system is antiquated, and patent litigation has injured the status of inventors immeasurably. The public utterly fails to appreciate that with the present organization of society only a small amount of research work can possibly possess any immediate value in dollars and cents. Research workers face the difficulty of the crudities of a new process or machine, the lack of commercial aids to its use and a cautious public.

What then are the remedies for this situation? The public must be educated by the press, by the platform, by the government and in the schools to the belief that research work is essential to the advancement and maintenance of civilization, that the reward for research must be more than publicity, medals, etc., and that the nation's leaders must include engineers and scientists.

Research workers should be organized. Very rarely can an old organization accomplish a new task. This new organization should not let itself become controlled by any other than research workers. In other words, research workers should not be as dependent upon business interests as they now are. The incorporation of research interests, somewhat in accordance with the idea of Dr. Cottrell, who was the originator of the Research Corporation, New York City, might improve conditions. In addition, the patent system should be improved so that inventors will be protected and will benefit by their work.

Summary of Investigations, Available Apparatus and Research Suggestions

INVESTIGATIONS UNDER WAY OR COMPLETED (RESEARCH WORK REPORTED SINCE AUGUST 18)*

AGRICULTURE, ELECTRICITY IN.

Experiments are being conducted on stimulation of growth of various vegetables and oats by means of electric discharges. The apparatus consists of a discharge coil, motor-driven current interrupter and Lodge valves. The discharge wires are of steel and are suspended over the field. It is too early yet to judge about the results.—*S. E. Britton, Chester, England.*†

CONTROL.

An experimental investigation of a new system for automatically regulating the voltage of an alternating-current circuit (just completed).—*John Alan Terrell, Rensselaer Polytechnic Institute.*

ELECTROMAGENTS.

Experiments on reaction time when closing and opening the circuit.—*F. E. Austin, Dartmouth College.*

LAMPS.

Tungsten lamps are tested for filament fragility, either hot or cold, under successive blows given in approximately the same manner and degree as the lamp is liable to encounter under actual service conditions. Lamps are swung through an adjustable arc and are tripped automatically by means of a motor-driven triple-pendulum device. Cold breakage is noted by galvanometer deflection. Current used, 0.015 amp. Failure when hot is noted by increased amperage due to shorter filament lengths. Current used is the same as the lamp rating.—*O. J. Bliss, Commonwealth Edison Company, Chicago.*

SIGNALING.

Methods for signaling by day and by night are being investigated and devised for the Signal Corps. A unique system is being tried out, which promises to be successful.—*F. E. Austin, Dartmouth College.*

SUGGESTIONS FOR RESEARCH

CORONA LOSS.

The measurement of corona losses at high voltages in a three-phase circuit, in which the three conductors are each in turn composed of three conductors separated from one another by from 12 in. to 20 in. (30.5 cm. to 50.8 cm.). The object of this arrangement is to reduce corona loss without an excessive size of conductor. At the present time we are faced with the difficulty of using higher voltages on account of corona, especially at high altitudes, and this expedient will, I think, be a practical method of increasing the present range with comparatively little complication or added expense. Should a commercial installation come up in which this system would be helpful, it probably could not be taken advantage of at the present time on account of lack of data as to the effect on corona of the separated elements of any one phase.—*P. H. Thomas, New York.*

CURRENT TRANSFORMERS.

An attachment or a modification of the usual construction that would compensate automatically for the error in the ratio and the phase angle.—*Editorial Suggestion.*

FLUE-GAS TEMPERATURE RECORDER.

Improvements are desired in electric or other thermometers for indicating and recording the temperature of flue gases in modern power plants. The device should be capable of showing the average temperature over a large cross-section, and the exposed parts must be so made that continuous immersion in hot flue gases would not affect the accuracy of the readings. Instruments of this sort should be so arranged that they can be installed at any convenient distance between the sensitive element or the bulb and the indicating and recording device, without affecting their accuracy. They should be so arranged that checking and calibration can easily and accurately be done.—*C. F. Hirshfeld, Detroit Edison Company.*

LIGHTNING ARRESTER.

At present there is no satisfactory lightning arrester for use on medium-voltage lines—that is, from 11,000 volts to 45,000 volts—under conditions such as we have in Georgia. The aluminum-cell arrester is not practicable because many stations are miles away from the nearest attendant. A cheap and satisfactory arrester is also needed for the protection of low-voltage customers' watt-hour meters.—*E. P. Peck, Georgia Railway & Power Company, Atlanta, Ga.*

TRANSFORMERS.

The origin and effect of third harmonics of voltage and current, especially those due to star-connected transformers and to their magnetizing current. I would suggest that measurements be made on a small electric circuit representing proportionately a large power system to determine the amount of oscillation of the neutral point of a star-connected three-phase group of primary windings and how this is affected by saturation in the iron and by the load on the transformer. The investigation should also cover the effect of charging current. What might be a critical condition consists in the grounding of the neutral in an extensive high-tension system by grounding the neutral point of a single-phase bank of star-connected transformers. In such a case we might easily get a triple-harmonic charging current equal to full load of the transformer. What would be the effect of such a current on the triple harmonic of the voltage wave?—*P. H. Thomas, New York.*

*The names of individuals given after each institution reporting investigations are those of persons with whom others interested should communicate. All institutions reporting research work should give such names.

†Reported in the *Electrician* (London), Vol. 79, page 613.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

HELP REMAKE THE WORLD

Leading Scientific and Engineering Schools of the Country Voice the Need of Technical Men

Thirty-eight of the leading scientific and engineering colleges of the country are engaged in advertising extensively in the leading daily papers the need which exists for technically trained men in the reconstruction of the world. It is pointed out in the advertisements that war is not only fought at the front, and that if one cannot serve there he should train himself technically to the direct production of clothing, chemicals, munitions and machinery of war. Then, when the days of reconstruction come, he can help to repair the ravages of war.

Extracts from messages delivered by President Wilson, Secretary Baker, Gen. W. N. Black, Major-General Wood and Colonel Tillman, all of which urge the young men of the country to devote themselves to the various branches of engineering education, form part of the advertisement. Attention is directed to the fact that our own railroads and industrial equipment will need rebuilding after the terrible strain of wartime and that the supply of technically trained men does not meet the demand now. When the war is over the demand will be still greater.

PENNSYLVANIA ELECTRIC ASSOCIATION CONVENES

Necessity for Increases in Rates and for Relief in the Present Coal Situation Among War Problems Considered

The tenth annual meeting of the Pennsylvania Electric Association, which was held at Bedford Springs, Pa., Sept. 7 and 8, was devoted exclusively to a consideration of the problems confronting the utilities in that State and attributable chiefly to the conditions arising from the war. It was pointed out by a number of speakers that the industry is to-day facing probably the most serious crisis in its history. The operation of various properties has become exceedingly difficult and has reached a point that tests to the fullest the optimism that has been so distinctly a part of the creed of electrical men. Aside from the address of President George B. Tripp, the only set addresses were made by Joseph B. McCall, president of the Philadelphia Electric Company; John W. Lieb, president of the National Electric Light Association, and W. D. B. Ainey, chairman of the Pennsylvania Public Service Commission.

PLEA FOR SMALLER NATIONAL CONVENTIONS

President Tripp in his address referred to the necessity for higher rates because of increased cost of operation. He was of the opinion that new conditions at the close of the war may produce a revolution in the industry and that only by the adoption of the most efficient and perhaps drastic methods will the utilities be in a position to cope successfully with the situation.

Mr. Tripp was in favor of making the National Electric Light Association solely a clearing house for policies and a limited amount of technical, commercial and executive matters pertaining to the industry and of increasing the scope of operations of state organizations. He expressed the firm conviction that the conventions of the national body have become unwieldy and inefficient and that the big convention has outlived its usefulness. He voiced the need of a convention of accredited delegates from state sections, together with executive and special representatives of the other classes of membership in the national body. Such a convention, he felt, would make for better efficiency and a stronger association. At his suggestion the executive committee appointed a special committee to review, study and report on a uniform plan for the valuation of utility properties.

THE HIGH COST OF DOING BUSINESS

Mr. McCall before discussing the exact needs of the industry pointed out that it is incumbent upon all to uphold the honor of the country and to aid in every way to keep the wheels turning in supplying materials and supplies and aid and comfort to those who go forth prepared to make the supreme sacrifice. Discussing the present situation, he said that not only have permanent organizations been disrupted but many more demands will be made for the service of the young men in our organizations. Competition for labor has increased to such an extent that the turn-over in labor is alarming. Among unskilled laborers the turn-over in the past six months is approximated at from 200 to 300 per cent.

The coal problem, in Mr. McCall's estimation, is the most serious one at the present time confronting the central stations. In many cases the cost of coal per kilowatt-hour at the bus is practically equal to the total operating busbar cost a year ago. He advised every operating man to buy every ton of coal he could possibly put his hands on and store it, because the combination of the government's demand for coal, the frightful shortage of cars and the shortage and high cost of labor make the outlook for coal this winter serious. Costs have also mounted in other directions. From actual figures taken from purchases made by the Philadelphia Electric Company the cost of wire and cable has increased in approximately two years 138 per cent; iron poles, 100 per cent; boiler tubes, 153 per cent; chemicals, 600 per cent; hardware for pole lines, 125 per cent; lead, 140 per cent; aluminum, 144 per cent; cast copper, 142 per cent; copper tubing, 220 per cent; sheet brass, 200 per cent; steel beams and bars, 208 per cent, and structural steel sheets, 218 per cent. The cost of transformers, feeders, regulators, generating apparatus,

etc., has increased from 30 to nearly 100 per cent in the same period.

Owing to the fact that manufacturers are relying on central stations more and more for power the ordinary and normal demand has been increased enormously. But, while desperate efforts are being made to add to equipment and distribution lines, prices are at the very top notch, and the industry faces the other serious difficulty of securing capital. From this Mr. McCall led to the question of rates and the necessity for obtaining some relief from the commissions. He did not believe in organized efforts for that purpose as it has been demonstrated time and time again that each case must stand upon its own feet. However, Mr. McCall believed that any company affected by the present high costs should lay its case promptly before the commission with the facts properly stated. He recommended also that increases needed to meet present emergencies be made for power and light customers of the wholesale class rather than for the residence class.

The Status of the Electrical Industry

Mr. Lieb told in some detail of the work of the national committee on gas and electric service and of the assistance it has been able to render the government in getting electricity to the various cantonments and how it has aided in other directions. As to exemptions of men from military service Mr. Lieb said emphasis is now being placed not on whether the man is needed by the company but whether his services are more necessary to the government in his job where he is or in the army. He also dwelt at length on the necessity for higher rates.

Because of the system of regulation to which the industry is committed and in which it firmly believes, the utilities find themselves in a position of diminished flexibility of action and diminished resiliency to meet promptly conditions created by the general industrial dislocation. Central stations are facing not only enormously increased costs for labor apparatus and supplies, but a scarcity and often the impossibility of obtaining any and all of them. Expenses are increasing much more rapidly than revenues and net returns are a diminishing quantity. Hence appeals of the utilities throughout the land for increased rates.

Mr. Lieb recommended that every company see to it that through proper avenues of expression the widest publicity be given the facts and data placed before commissions as a basis for applications for increased rates. Since claims for increases are not heard for or on behalf of groups, they must be presented by the individual company. Each company as its case is presented and its local situation unfolded should see it as a definite part of its public policy to spread the facts before its local public. Mr. Lieb is of the opinion that the industry is approaching the period when high prices for materials and labor are no longer a transitory phenomenon but apt to extend over a large period of time, so that the necessity for increased rates must be considered seriously. He said that the industry has hardly risen to a realization of what this great war really means to the nation, and it is difficult to appreciate all the sacrifices we may be called upon to make; but whatever they are, the utilities of the country are ready to do their part and none will be found more willing to make such sacrifices and to give such co-operation and support to the government as may be necessary to bring the conflict to a successful conclusion than our own.

Election of Officers

The officers for the ensuing year were elected as follows: President, Henry N. Müller, Pittsburgh; first vice-president, Thomas Sproule, Philadelphia; second vice-president, Ernest H. Davis, Williamsport; treasurer, W. R. Kenney, Connellsville; secretary, Henry M. Stine, Harrisburg. The executive committee remains the same.

JOVIAN CONVENTION WILL BE HELD AT NEW YORK CITY

Proposals of Vital Changes in Existing Method of Operation to Be Made at Annual Meeting on Oct. 22 and 23

In order to decrease the difficulty of securing the necessary quorum to transact business, the annual convention of the Jovian Order will be held in New York City at the Hotel McAlpin on Oct. 22 and 23.

In announcing the plans for the convention the following statement is made by the order:

The convention will, as of old, and as no other convention does, furnish a common ground upon which shall gather all branches in the electrical field for the charting of co-operative effort to advance those endeavors which affect the industry as a whole.

At no other period in the history of electrical development has it been as necessary as it is to-day that each branch of the industry recognize in a practical manner its interdependence with relation to all other branches and the necessity for co-ordinated effort.

In appreciation of the wonderful vehicle afforded by the Jovian Order to develop to the maximum degree this spirit of intercommunion between all divisions of the industry, a specific, thoroughly workable plan will be presented for the consideration of the convention, whereby Jovianism may be immediately employed for this helpful purpose.

This convention is of utmost importance. There will be presented for its acceptance or rejection extremely vital changes in the existing method of operation of the Jovian Order.

It is the belief of not an inconsiderable number of Jovians that upon the passage of some or all of the proposed amendments depends the future upward progress of the order.

It is needful to place especial emphasis upon this fact—no amendment can be acted upon unless not less than 200 Jovians in good standing are present at the meeting at which the amendment is voted. That number is specified by the Jovian constitution as the required quorum.

To secure this quorum it is imperative that every Jovian who can possibly attend, even at some personal sacrifice, shall do so. There will be much in the convention itself that will make the effort worth while, and there are few who cannot find within New York City many ways in which to employ profitably a few extra hours afforded by the trip.

The program will include addresses by capable speakers of national and international fame on subjects bearing upon the newer problems of our industry induced by the European conflict. Throughout the business of the meeting and in a number of specific ways a note of patriotism will run, which will culminate on Tuesday evening with a simple dinner, when the newly elected officers of the order will be welcomed.

No special arrangements have been made for transportation. It will be advisable for delegates to make Pullman reservations at the earliest moment practicable. Frank E. Watts, 30 Church Street, New York City, chairman of the hotel committee, will have charge of reservations.

WAR REVENUE BILL NOW IN CONFERENCE

Western Members of House Believe that a Method of Imposing a Tax Upon Electricity Can Be Devised

The war revenue bill was sent to conference between the houses of Congress in the past week. The fate of provisions of this measure will depend very largely upon the members of the House who have been appointed as conferees. These are as follows: Democratic Leader Kitchin and Representatives Rainey, Dixon, Fordney and Moore. The names of the Senate conferees have already been reported in these columns.

When the House of Representatives sent the war revenue bill to conference there was some preliminary skirmishing which might seem to indicate that when the bill comes back before the House for adoption in the form of the conferees' report some attempt will be made to oppose it. There are certain differences between the House and the Senate on this bill, particularly in regard to excess profit taxes and income taxes. Members of the House of Representatives believe that a different method of raising excess profits from that which has been devised in the Senate bill could be provided by the House. Some of the Western members of the House also believe that a method of taxing electricity could be devised. The question will come up for discussion among the House conferees, who are expected before they begin their work with the Senate conferees to ascertain the final opinion of all members of the House interested in the question. The history of revenue bills in Congress, however, is that while they always originate in the House of Representatives they are usually remade and whipped into final shape in the Senate. Under these circumstances it is expected that the war revenue bill, as it has now come to the hands of the conferees, will become a law within ten days or two weeks.

MUNICIPAL ELECTRICIANS AGAINST CONCENTRIC WIRING

Annual Convention at Niagara Falls This Week Emphasizes Safety Promotion and Rules of Standardization

Patriotic pledges, action on concentric wiring and the National Electrical Safety Code and numerous other matters received attention from the International Association of Municipal Electricians at the annual meeting in Niagara Falls, N. Y., this week. The sessions were held in the auditorium of the Cataract House.

The association indorsed a telegram pledging support and co operation to President Wilson which was sent by the executive committee last spring. Its president, Robert J. Gaskill, Fort Wayne, Ind., now serving with the national forces, sent an address calling upon each one to do his part. Acknowledging the greeting, the association sent messages to Mr. Gaskill and to two other members who are enlisted with the nation's defenders, A. L. Pierce, Wallingford, Conn., and George E. A. Fairley, Baltimore. Telegrams were also sent to the wives of these men congratulating them upon the readiness of their husbands to serve the national cause.

A resolution bearing upon concentric wiring was passed at the close of the second day's session on Wednesday. It was offered by W. H. Flandreau, Mount Vernon, N. Y., a member of the sub-committee on bare grounded-return wiring systems of the committee on electric wiring systems, which reported March 1 last.

The resolution says that such systems have great demonstrated disadvantages and no demonstrated advantages from the standpoints of life and fire hazard as compared with present systems of wiring in this country, and that they do not comply with the rules of the National Electrical Code and the National Electrical Safety Code, which meet in a satisfactory degree all conditions obtaining in this country for the best protection of life and fire hazard conditions in step with the progress of the electrical industry. The association, therefore, unqualifiedly indorsed the findings and report of the electrical industry sub-committee on bare grounded-return wiring systems.

R. A. Smith, Norfolk, Va., offered the resolution which was passed on the National Electrical Safety Code. It provides that every member shall be furnished with a copy of the code and that the association recommend to its members that operating companies in the vicinity be requested to live up to the code as far as practicable.

ADDRESS OF THE PRESIDENT

Mr. Flandreau called the convention to order and read the address of the absent president, Mr. Gaskill, which called attention to the fact that one of the most important things in connection with the association is that it meets at a time when a number of organizations, both state and national, have abandoned their conventions under the impression that this would be economical.

"That this association had the fortitude to go ahead and arrange this meeting," said Mr. Gaskill, "shows that we are progressing. Later events, I am sure, will show that we have done the proper thing. We must realize at this time that the business of our country needs to be stimulated and enlarged so as to give the common enemy the knowledge that, in spite of the war, our industry and business will suffer in no way; and as the final winning must be by industry and business co-operation as well as by the force of arms, all things that tend to keep the industry and business on an active plane will have a salutary effect.

"There is no doubt in my mind," he added, "that we as a national association can be of immense benefit to our country. The part that we have as individuals will probably depend on our respective abilities. To some it will mean remaining in our present positions and doing better than ever before. To some it will mean changing to places in the industrial world where they will be of most benefit. To others still it will mean taking up arms and going to the battle front. But no matter what part we as individuals take, we shall all be working toward the same definite conclusion—a world democracy."

R. A. Smith, Norfolk, Va., chairman of the standardization committee, presented a preliminary report. The general plan was indorsed and the committee continued as a permanent standing body. Its report is a comprehensive outline of all of the possible activities of a city electrical department, embracing fire alarm, telegraph, police signal telegraph, construction and operation and lighting and power plants.

C. E. Corrigan, National Metal Molding Company, Pittsburgh, stated in a paper that seventy-one United States and Canadian cities are reported to have established zones in which only metallic construction is permitted.

Mr. Corrigan also said that the fine attitude of this country in fighting for democracy against autocracy without expectation of reward must leave its impress on the world for the betterment of human conditions and affairs. It would seem logical to conclude, he added, that after the great conflict is terminated this foremost republic will enter an arena of activities and importance as the model for the best expression of the individual development and advancement of citizenship and will be called upon hereafter to direct largely the world's developments.

Other papers on the program were: "Phantom Circuit Remote-Control Systems," by H. H. Reeves, General Electric Company; "Practical City Street Lighting," by Frank J. Dix, Fort Wayne, Ind.; "Renewable Types of Inclosed Fuses," by A. L. Eustice, Economy Fuse & Manufacturing Company; "Police Signaling Systems as Affecting Municipal Electricians," by E. E. Salisbury, Gamewell Fire Alarm Telegraph Company; "Buffalo's New Police Signal System," by Gustave F. C. Bauer; "The Growing Tendency Toward Surface Wiring for the Sake of Flexibility and Economy in Many Classes of Buildings," by C. W. Abbott, American Conduit Manufacturing Company, Pittsburgh; "Fire Hazards of Domestic Electrical Appliances," by W. J. Canada, Bureau of Standards, and "Common Battery Service Operating Fire Alarm Circuits," by J. B. Yeakle, Baltimore, Md.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES

Formal Convention Held in New York City to Satisfy the Requirement by the Constitution of an Annual Meeting

The annual convention of the Association of Edison Illuminating Companies was held in the Engineering Societies Building on Tuesday, Sept. 11, and was called to order by Vice-president L. L. Elden of Boston, in the absence of Major P. Junkersfeld, who is engaged in military service.

In view of the war-time conditions the convention was purely a formal one to satisfy the requirements of the constitution. No papers were read and no entertainment of any kind was provided. There was a limited representation of member companies, principally by delegates from the larger near-by organizations.

The report of the executive committee was presented, and the report of the lamp committee was presented in abstract by its chairman, John W. Lieb.

A committee was appointed to draw up resolutions in memory of the late E. H. Johnson, an honorary member of the association.

A detailed report was presented in behalf of the National Committee on Gas and Electric Service, J. W. Lieb chairman, regarding the work of the Washington headquarters, the Association of Edison Illuminating Companies being one of the national bodies co-operating with the committee.

The convention reflected war-time conditions, and the session, lasting less than two hours, was taken up with a general discussion of conditions in the industry resulting from the state of war.

BROAD CONSTITUTION FOR ELECTRICAL CONTRACTORS

James R. Strong Outlines the Plan for Enlarging and Strengthening the Organization of This Branch of the Industry

The proposed constitution and by-laws of the National Electrical Contractors' Association, upon which action is to be taken at the annual meeting in New Orleans in October, will greatly broaden the scope and opportunities of that organization to render useful service to this branch of the industry. Adoption of the new measures will also promote the co-ordination of the industry toward which all other branches are working.

James R. Strong, Tucker Electrical Construction Company, New York, is the chairman of the committee appointed by the executive committee in Chicago on June 19 and 20 to prepare a revision of the constitution for submission at the next meeting. The other members of the committee are William L. Goodwin and Earnest McCleary.

DETAILS OF THE NEW ORGANIZATION PLAN

Mr. Strong in an interview with a representative of the ELECTRICAL WORLD explained the large purpose of the committee and the far-reaching organization which it is hoped will be developed under the new plan. The title of the organization will be changed to National Association of Electrical Contractors and Dealers.

"The revised constitution," said Mr. Strong, "will broaden the membership by providing two classes of members. The first class will be practically the old members, only electrical contractors, who will be called members. The second class, associate members, would include those who sell electrical supplies at retail as a department or minor part of their business, such as hardware stores and department stores; this class was not included under the old constitution. The change in name therefore signifies a real change, bringing in the man who sells supplies as well as the man who installs them; in other words, all of the retailers of electrical supplies as distinguished from the jobbers.

"Membership in the new national association will be held through membership in state and local associations. This plan will lead to more frequent large meetings of contractors in various parts of the country. The new constitution provides for Atlantic, Central and Pacific divisions. They will hold meetings at least twice a year, apart from the national meeting. The divisions are not legislative bodies, but they will afford an opportunity for broader views than the state meetings.

"The divisions will be composed of state associations, which will have about the same functions as the present state associations, except that they have a very important part in national affairs. The state associations in turn are composed of district associations which are divided along territorial lines, that is to say, with a city as the center and the surrounding country. The state meetings would be held twice a year and the district meetings monthly. We expect that this plan will

create a much greater interest in the districts and states in the work of the national association.

"The whole aim of the movement is to educate the contractor, to teach him that he is the retailer and that the jobber is not, to show him how to conduct his business, to fit him gradually to do the merchandising as well as the contracting part of the business, and also to teach him to demand from the manufacturer and jobber a trade protection which he has not now.

"This plan is not new in other lines of business. It is not new in our own business so far as the Pacific Coast is concerned. There this plan has been in operation for three or four years, and it has gradually become very effective and satisfactory not only to contractors but also to their allies in business, the central stations, manufacturers and jobbers.

"It is expected that through the increase in membership which is bound to come under this plan the buying powers of electrical contractors and dealers will be much enlarged and their influence will be felt more and more with other branches of trade.

"Another feature of the new constitution is the system of graded dues, by which the very smallest may be a member for $5 and the larger payments are based on the amount of business done, making the larger man do his part in proportion to the size of his business, as I have every reason to believe he is willing to do.

"The national constitution also provides a form of state constitution. It is along the same lines as the national constitution, and its adoption is obligatory upon the affiliated state organizations. Amendments to the constitutions of state associations do not become operative until approved by the national association executive committee.

"The endeavor is to take all matters which involve association politics out of the hands of the association as a whole and put them in the hands of the executive committee. The object is to bring before the association meeting only matters which affect a man's real business. Therefore the entire management, it is provided, shall rest with the executive committee of seventeeen members. Of these, three will be members-at-large, six will be from the Atlantic division, six from the Central division and two from the Pacific division, which is relatively smaller in numbers than the others. This committee will control the affairs and funds. It will appoint the three officers, chairman, secretary and treasurer."

The broad scope of the new organization is indicated by the following extract from the proposed constitution:

The objects for which this association is formed are:

To promote the welfare of its members.

To distribute among them the fullest information obtainable in regard to all matters affecting the electrical contracting and retail electrical merchandising business.

To issue engineering and data sheets required in electrical engineering and electrical contracting problems.

To collect data relating to the business of electrical contracting and retail merchandising.

To aid in bringing about more friendly relations between electrical contractors and electrical retail dealers and others engaged in the electrical industry.

To assist in marketing high-grade electrical material and apparatus of American manufacture.

To encourage its members in establishing and conducting attractive retail electrical stores.

To elevate the standard of electrical installations.

To co-operate with the National Fire Protection Association with a view to improving the quality of electrical material as well as its installation.

To co-operate with the American Institute of Electrical Engineers in the solution of all electrical engineering problems—particularly the preparation of and compliance with standard specifications.

To co-operate with the American Institute of Architects in recommending standard and improved electrical specifications.

To co-operate with all wholesalers of electrical supplies in the study of distribution, standardizing of packages and catalog numbers and in reducing the expense of wholesale electrical merchandising.

To co-operate with the National Electric Light Association, its members and all other public service and municipal electric light and power companies in their endeavor to solve all problems tending to improve service to consumers.

To co-operate with the National Electrical Credit Association.

To collect and diffuse information affecting merchants, manufacturers, builders and others engaged in erecting buildings.

The proposed preamble shows the desire to conform strictly to the law:

Whereas the members of this association desire to conduct the business of the association in conformity with the law, but may from time to time, through mistake, take or decide upon action which may be considered illegal or improper; now, therefore, be it

Resolved, That any and every resolution hereafter adopted or motion hereafter carried by this association or a division or a committee hereof which in the opinion of counsel is contrary to law or to the plan of operation under which the association is then acting shall be for all purposes treated as null and void, and any and all action taken under any such resolution or motion shall be also for all purposes treated as null and void.

It shall be the duty of the national executive committee at its first meeting after election each year, the proposed constitution provides, to select from its membership the individuals to serve as chairmen in charge of the following subjects: Industrial development, universal data and sales book, National Electrical Code, membership, legislation, labor, publication, liability insurance, conventions and meetings, credit, credentials, house wiring, merchandising, jobbers, manufacturers, central stations, architects, engineers. Such member will act as chairman during the consideration of such subject.

ANNUAL MEETING OF IRON AND STEEL ELECTRICAL ENGINEERS

Seriousness Marked This Convention of Electrical Engineers Because of Their Task to Increase Iron and Steel Production

Complete electrical equipment of steel mills, the education of men and standardization of equipment were the main thoughts at the eleventh annual convention of the Association of Iron and Steel Electrical Engineers, held at the Bellevue-Stratford Hotel, Philadelphia, Sept. 10-14 inclusive. The members of the association, who are representatives of the steel mills of the country, came to the meeting in a more serious mood than ever before to discuss plans and advance ideas by which they can further the outputs of their plants in a more economical manner during the present war. Most of the plants are operating twenty-four hours per day, and electricity is playing a greater part every year. The use of electric furnaces and equipment will more than double this coming year, and methods of forwarding this movement were advanced. Central stations will also play a very important part in the steel industry.

The convention opened Monday, Sept. 10, with a business session in the morning, which included the reports of committees and the election of officers. The question of organizing a new committee, to be known as the blooming-mill committee, was discussed, but not decided at the time of going to press. The total attendance of members and guests was about 550.

The officers elected for the coming year are as follows: President, C. A. Menk, superintendent electrical department Carnegie Steel Company, Homestead Works, Munhall, Pa.; vice-president, S. C. Coey, assistant superintendent mechanical and electrical department Youngstown Sheet & Tube Company, Youngstown, Ohio; second vice-president, D. M. Petty, superintendent electrical department Bethlehem Steel Company, South Bethlehem, Pa.; secretary, J. F. Kelly (re-elected), general foreman electrical department National Tube Company, McKeesport, Pa.; treasurer, James Farrington (re-elected), superintendent electrical department La Belle Iron Works, Steubenville, Ohio.

Patriotism was the dominant note at the annual banquet, at which more than 500 guests were present. Gano Dunn, who acted as toastmaster, emphasized the solemnity of the occasion and that each one had an important part to play. The speakers were former Senator Theodore E. Burton of Ohio, F. D. Egan, president of the association during the past year, E. J. Cattell of Philadelphia, John B. Finley, Thomas Raeburn White and C. A. Menk, the newly elected president. Mr. White outlined the objects and means of the League to Enforce Peace.

At the Monday afternoon session Walter Greenwood presented a paper on "Safeguarding Electrical Equipment," and Walter C. Kennedy presented a paper on "Heroult Electric Furnaces." In the discussion of Mr. Greenwood's paper it was strongly emphasized that to minimize accidents the men must be educated to think "safety first" always. Results in the use of various types of safety appliances were given, particularly in the use of fixed stops on runway tracks to prevent cranes passing a given point intermediate between the ends of runways. The general principles that should govern, for safety, in the construction of switches brought out many interesting points. In the discussion of the second paper means for reducing skin effect of the conductors were brought out, the author pointing out that the phases should be broken up, say into six leads, with the phases interlaced. These six, or possibly twelve, leads should run from the transformer to the furnace. The delta connection should then be mounted on the furnace.

Brent Wiley presented a paper on "Factors Relating to the Economical Generation and Use of Electric Power in the Steel Industry," and Joseph McKinley and Ray L. Baker a paper on "Central Station Power Supply to the Iron and Steel Industry," at the Tuesday morning session. In the discussion it was brought out that central station companies are of more value to the steel industry than ever before as they are furnishing excellent service at low rates and are always prepared for emergencies.

A paper on "Electrical Reversing Blooming Mills," by Ralph D. Nye, was read by J. H. Albrecht, and D. M. Petty presented a paper on "Electric Drives for Reversing Rolling Mills," at the Tuesday afternoon session. The first paper gave some data pertaining to and the results which have been secured from two typical installations. In the second paper the factors that enter into the cost of rolling steel in the mill and how these costs may be kept down to a minimum were discussed. The three items that enter into the cost of rolling steel which are affected by the drive are cost of equipment, efficiency, and reliability. To keep the rolling costs down, the author pointed out, delays must be eliminated. This is best accomplished by designing all parts of the equipment with a large factor of safety, making it simple to operate as well as easy to repair. It was suggested that the rating of reversing mill motors be standardized. The question of whether compounding characteristics are desirable in motors was argued from both sides.

"Fuel Economy by Co-operation in Establishing a Better Practice in the Operation of Stokers and Boilers," by Joseph G. Worker, and "Turbo-Generators," by Richard H. Rice, were the papers presented at the Wednesday morning session. Emphasis was laid on the point that technically trained men should be placed in every boiler plant. An operating force must be built up to take care of high-class equipment to secure results. The smaller plants, where most fuel is wasted, should study and apply methods followed by larger plants to obtain best economy in the operation of stokers and boilers.

On Wednesday afternoon E. H. Martindale presented a paper on the "Manufacture, Selection and Use of Carbon Brushes," followed by a patriotic meeting. The speakers were E. J. Cattell of Philadelphia, Harry S. Brinker, president Lehigh University; Colonel James A. Andrews, New York, and Walter Greenwood. The latter two are members of the association.

On Thursday the reports and recommendations of the standardization committees were presented and discussed. Two papers were presented on Friday, namely, "Grab-Bucket Coal Hoists Operated by Alternating-Current Motors with Dynamic Braking and Regenerative Braking," by James Farrington and R. H. McLain, and "Tool Steel Gears and Pinions for Mill and Industrial Service," by E. S. Sawtelle.

Friday afternoon was spent in the inspection of plants, automobile rides and other entertainment.

UNDERWRITERS WILL DISCUSS CODE REVISIONS NEXT MONTH

The March Meeting of the Association, Which Was Halted by Injunction, Will Reconvene in New York to Consider Changes Then Proposed

Chairman Cabot of the electrical committee of the National Fire Protection Association has issued a call for a meeting to be held in the rooms of the New York Board of Fire Underwriters, 123 William Street, New York, on Oct. 23 and 24. It will be recalled that the biennial meeting of the committee, at which changes and revisions in the National Electrical Code are considered and acted on, was summarily adjourned on March 28 a few minutes after it began owing to an injunction issued to a manufacturer of fuses. That meeting will now reconvene and consider the various reports and suggestions contained in the bulletin issued by the National Fire Protection Association under date of Feb. 15 relative to the code.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Increase in Cost Is Real, Says Maine Commission.—In dismissing a complaint against water rates of the Peaks Island Corporation, the Maine Public Utilities Commission says: "We know that the present cost of operating such a plant is very much in excess of the average cost of equally careful operation during previous years. It would be an insult to public intelligence to claim otherwise. How much more expensive it must be, or how long this condition will continue, no one can tell. But the increase is real, and public utilities, like all other undertakings, must be permitted to consider it to some extent in their rates. The fact that a corporation is a public utility is not sufficient reason why it should pay more for supplies, more for taxes, more for insurance, more for labor, more for everything that goes into the cost of operation, and receive no more for its product, although it may not be permitted to shift the entire burden to some one else. It must stop somewhere, and everybody must bear a share of the increased cost."

Potomac Power Company Rate Case.—The District of Columbia Public Utilities Commission has filed an answer to the bill of complaint of the Potomac Electric Power Company, Washington, in the rate and valuation case, hearings on which have been begun before Justice Hitz. The commission states that the report on the actual cost of the property of the company as disclosed by its records was as accurate as could possibly have been made, considering the way in which the records of the plaintiffs and its predecessors had been kept; that the unit prices applied were fair, just and reasonable, and that all intangible elements of value of every kind and character were carefully considered and received full allowance. "Notwithstanding the obstinate and unhelpful attitude of the plaintiff," continues the answer, "the commission proceeded with its work and completed the report now before the court, both as to the historical cost and reproduction cost, in accordance with the most scientific methods known to valuation bureaus." The commission states that "from its consideration of the fair value of the property of the company and its study and analysis of the rates, tolls and charges being made by the company it appeared to it that some of the rates, tolls and charges were excessive, and in fairness and justice to the public should be reduced." Concerning the contractual relations between the company and the Washington Railway & Electric Company, the commission states that this is open to the most serious question. It avers that the contract under which the railway company would have the preferential right to receive from the power concern as much electrical energy as it might require—payment to be made at the actual cost of production, inclusive of interest at the rate of 6 per cent a year on the property of the plaintiff employed in such production—never was lived up to; that as a result of modifications in the contract the plaintiff not only received no profit on the electrical energy taken by the railway company and no interest on its investment, but that it paid more than its just proportion of the expenses of generating the power.

Service Charge in New Jersey.—The New Jersey Board of Public Utility Commissioners has denied the application of the New Jersey Northern Gas Company, operating at Hopewell, Pennington and vicinity, for permission to increase the cost of service from $1.40 to $1.90 per 1000 cu. ft. In the new schedule proposed by the company a fixed service charge of 50 cents per month in addition to the $1.40 rate was suggested to make the total noted. The board held that the testimony offered did not indicate how much additional revenue the proposed increased rate would give, and that the practical result of the new rates would be to increase present charges to small consumers and decrease those to large consumers. The board also mentioned that there was no satisfactory proof that the service charge proposed by the company bears a proper relation to the cost of readiness to serve.

Large and Small Consumers.—In a recent decision affecting the Colorado Springs Light, Heat & Power Company the Colorado Public Utilities Commission says: "The consumers of the company may be divided into two general classes. The first of these classes consists of a large number of small consumers whose consumption comprises only a small portion of the annual kilowatt-hour sales. The second consists of a small number of large consumers whose consumption comprises a large portion of the kilowatt-hour sales. The rate paid by the small consumer is based very largely upon fixed charges or upon expenses which are not of a variable nature. Only a very small portion of the rate paid by such consumer is based upon operating expenses, so that as a whole the cost of serving him has not materially increased. The rate paid by the large consumer is based to some extent upon the fixed charges upon the investment in the property assignable to him, but to a greater extent upon operating expenses. The increase in the cost of coal and labor affects materially the cost of serving such a consumer, and the commission is of the opinion that the rate schedules hereinafter provided should be such that a large portion of the company's increase in operating expenses will be borne by its large consumers. The increase hereinafter provided will apply to consumers who use in excess of 85 per cent of the total output of the company."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Commission's Consent Not Required to Remove Wires on Expiration of Franchise.—The act creating the Public Utilities Commission and giving it power to regulate and control public utilities and common carriers did not repeal the statute which expressly gives the mayor and council of cities of the second and third classes the control of the streets, alleys and public grounds of such cities, the Supreme Court of Kansas held (166 P. 572). Where a franchise previously granted by a city to a public utility for the use of the streets, alleys and public grounds on which to erect an electric lighting plant for the distribution of electric light and power has expired, and the city is taking steps to cause the removal of the poles and wires which had been placed there by the public utility, the consent of the Public Utilities Commission for such removal or for the discontinuance of the service which is no longer authorized under the franchise is not required by the statutes of the State.

Prescribing Device for Measuring Quantity of Water.—Where complainant claimed that defendant was violating a grant of water-power rights, but that it was impossible to measure the excess accurately, a judgment requiring defendant to use some device for accurately measuring the quantity of water used was proper, so that it could be inspected by the plaintiff and others interested, the Appellate Division of the Supreme Court of New York held (166 N. Y. S. 311). Where parties to water-power grants practically divided among themselves the remaining water rights, each receiving the same form of deed as descriptive of the rights conveyed, one of these grants could not be construed most strongly against the grantors in the case of an ambiguity. Where a grant has been held to be of so much water as would pass through a prescribed aperture under all the head available, a judgment requiring defendant to take such water through a standard rectangular aperture of metal with square edges, which was to open into a well-secured and tight flume or bulkhead, was proper, since the grant was not capable of interpretation in terms of a constant flow of a given amount of water, because it fixed no definite head, and the effect of the prescribed aperture would regulate the flow to defendant's wheels accordingly, the aperture being a standard orifice the character of which was presumably known to hydraulic engineers at the time when the grant was originally made to the defendant.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

New Stock Offering Contemplated in St. Louis.—The Union Electric Light & Power Company, St. Louis, which sold recently $1,000,000 of preferred stock to consumers, is considering plans for offering an additional $1,000,000.

War-Time Values Claimed for Municipal Plant.—The city of Alameda, Cal., claims an additional value in its municipal lighting plant because of the increase in material costs during the last few years. City Manager C. E. Hewes declares that the value of the plant has increased from $408,000 to $600,000. His statement is based upon a report prepared by A. D. Goldsworthy.

Valuation in Washington.—The chief engineer of the Washington Public Service Commission has submitted his report on valuation of the water and electric systems of the Washington Power, Light & Water Company at Anacortes, Wash. The work was begun in April of this year. The reproduction cost of the water system is given as $224,108 and that of the electric system as $98,413, making the total $322,521.

Tax Valuations in Ohio.—An announcement from the Ohio Tax Commission shows that since 1910 the tax valuation of light and power companies has been increased 856 per cent. In 1910 the valuation was $6,387,730, and this year the aggregate is $54,639,600. The increase over last year is $8,465,450. The valuations of the various plants range from $250 to $22,099,770, the Cleveland Electric Illuminating Company total.

Cleveland Electrical League Furnishes Candy for Pershing's Men.—Recognizing that soldiers need and appreciate "sweets," the Cleveland Electrical League announced recently that it had purchased 2000 lb. of candy to be sent to General Pershing's men in France, and that 100 young women would meet in the league's rooms to pack it. For convenience in transportation the candy was packed in 20-lb. boxes. The work was done under the direction of Secretary R. S. Dunning.

35,300-Kva. Generator Started at Chicago.—The new 35,300-kva. Westinghouse-Parsons turbo-generator which was purchased about two years ago by the Commonwealth Edison Company for installation at the Northwest Station was placed on that company's system for the first time on Aug. 21. Work on the armature for the mate of this unit is nearing completion. A 35,000-kw. General Electric turbo-generator is also being erected. These three units will give the Northwest Station a total rating of 135,000 kva.

Cleveland Municipal Plant Will Get Transformers.—Within a short time the municipal light plant at Cleveland, Ohio, will receive twenty transformers on which shipment had been delayed by an embargo. Mayor Harry L. Davis had written Secretary of War Baker urging that the embargo be lifted on this particular equipment, and stating that plants making war materials would be affected if the transformers were not received soon. Several were burned out during a recent storm and there was not one in reserve at the plant.

High-Priced Coal at Trumbull, Ohio.—The Trumbull Public Service Company, Warren, Ohio, has made recently a contract for coal at $3.75 per ton at the mine. In commenting upon this E. L. Franklin, general manager of the company, says: "This seems to be an outrageous price, but after canvassing the situation pretty thoroughly we came to the conclusion that it was the best we could do. We are not particularly pleased with our achievements in this coal contract, but we are unable to see any other way out by which we could assure ourselves a supply of coal."

Minimum Charge Increased by Municipal Plant at Cleveland.—Light Commissioner W. E. Davis of Cleveland, Ohio, has announced that a minimum charge of $1 per month is being required of about 10 per cent of the municipal light plant patrons, while the others are still under the rule requiring a minimum of 50 cents. Those paying the larger minimum are either large consumers or persons to whom the charge is applied at the discretion of the officials. The city may also require a deposit of $5 under rules of the Board of Control, if it is found necessary to do so.

Cincinnati to Install Boulevard Light System in Business Streets.—The construction of a comprehensive system of boulevard lighting will be begun in Cincinnati (Ohio) within sixty days. The City Council has authorized Director of Public Service Hornberger to advertise for bids for the installation of boulevard lights on Third Street from John Street to Central Avenue, and on Central Avenue from Third to Twelfth Street. Legislation authorizing contracts for the same kind of lights on Main, Vine, Walnut and Eighth Streets will be introduced in the Council in September and other streets will be considered at later meetings.

Lowering of Bond Prices in California.—The San Diego (Cal.) Consolidated Gas & Electric Company has filed with the California Railroad Commission an amendment to its recent application so as to permit it now to issue $500,000 bonds and to pledge them at not less than 80 per cent of face value to secure an issue of two-year 6 per cent notes to be sold at not less than 98. The company also wants to sell from time to time this $500,000 issue at not less than 88. In the original application the company estimated that its bonds could be sold at 90, but it says now that it cannot sell them at present or in the near future at this figure, or even at several points less.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

British Columbia Electrical Contractors.—The annual convention of the British Columbia Electrical Contractors was held on Sept. 11 to 15 at Vancouver, B. C. C. H. E. Williams is president of the organization.

Jovian League of New York City.—Robert Adamson, Fire Commissioner of New York City, who was recently nominated on the fusion ticket for President of the Board of Aldermen, spoke at the Jovian luncheon on Sept. 12.

Colorado Association to Hold Annual Convention.—The annual convention of the Colorado Electric Light, Power and Railway Association will hold its annual convention at Colorado Springs, Col., Sept. 20-22. T. F. Kennedy, 900 Fifteenth Street, Denver, Col., is the secretary of this association.

Annual Convention of the National Safety Council.—The sixth annual safety congress of the National Safety Council was held at the Hotel Astor, New York City, on Sept. 10 to 14. One of the special features of the congress was the National Exposition of Safety and Sanitation at the Grand Central Palace. A co-operative arrangement was made with the American Museum of Safety as the result of which there was one national comprehensive safety exhibit this year.

Electrical Contractors' Association of Massachusetts.—This association will hold its annual meeting at Worcester, Mass., Sept. 20, at the Hotel Bancroft. At this meeting William L. Goodwin of California will outline a plan which he proposes to submit to the members of the National Electrical Contractors' Association at New Orleans in October. The proceedings of the meeting will be reported to the meeting of the National Electrical Contractors' Association at New Orleans by the directors from Massachusetts.

Kansas City Society Has Outing.—The Southwest Illuminating Society, at present composed of dealers selling fixtures in Kansas City, Mo., held an outing recently that indicated the goodfellowship that prevails and the extent of the organization. The society is proceeding with its important work of developing a credit interchange department and is planning extensive educational work on cost systems. A. Viner, elected secretary at the organization meeting last April, has resigned, and James Mundstock, of the Western Chandelier Company, has been elected to succeed him. The society now has thirty members, including a few salesmen who hold individual memberships.

Frank Wright, Collingswood, N. J., has been appointed superintendent of the municipal electric lighting plant of Quakertown, N. J.

C. B. Hayden, formerly district inspector for the State Engineering Department of Wisconsin, has been appointed to succeed J. N. Cadby, who has resigned.

Charles B. Hart, former head of the new-business department of the Fort Wayne & Northern Indiana Traction Company, has been made manager of the light and power department of this company.

Boyd E. Hannon has resigned his position as manager of the Sacramento (Cal.) division of the Great Western Power Company, having enlisted in the Signal Reserve Corps of the United States Army.

J. N. Helpbringer has resigned as power plant engineer of the Firestone Tire & Rubber Company to become superintendent of power plants of the Kansas Gas & Electric Company, with headquarters at Wichita, Kan.

Ernest S. Meyers, former manager of the light and power department of the Fort Wayne & Northern Indiana Traction Company, has resigned to accept a similar position with the Vicksburg (Miss.) Light & Traction Company.

C. S. Jenner, assistant general manager Porto Rico Railway, Light & Power Company, San Juan, P. R., has resigned, to enter business on his own account. Mr. Jenner has successively held the positions of auditor, comptroller and assistant general manager.

D. R. Shearer, formerly engineer for the Boone Fork Lumber Company, Shulls Mills, N. C., has opened an office in the Burrow Building, Johnson City, Tenn., for the practice of engineering, specializing in the design of steam, hydroelectric and automatic power plants of several types.

John H. Lucas, who has been president of the Kansas City (Mo.) Light & Power Company since its reorganization and separation from the railway interests, has retired. Mr. Lucas had previously been general counsel for the light company and for the Metropolitan Street Railway Company, the predecessor of the present Kansas City Railways Company. He is nearly seventy years of age.

Joseph F. Porter, president of the Tri-City Railway & Light Company, Davenport, Iowa, has been made president of the Kansas City (Mo.) Light & Power Company. Mr. Porter has held the presidency of the Davenport company since 1906. In addition to being president of the Tri-City Railway & Light Company, Mr. Porter was president of the Tri-City Railway Company, the People's Light Company, the Clinton, Davenport & Muscatine Railway Company, the Moline, Rock Island & Eastern Traction Company, the Moline Lighting Company, the People's Power Company and the Moline-Rock Island Manufacturing Company. Mr. Porter was born in Harrison County, Iowa, in 1863, and was graduated from the State College at Ames in 1884. Following his graduation he took part in the construction of electric lighting and street railway properties for the Edison interests and for J. G. White & Company at a number of points, among which were Des Moines, Iowa; Appleton, Wis.; Chicago; Abilene, Kan.; Kansas City, Mo.; New York City, and Alton, Ill.

Men of the Industry

Changes in Personnel and Position—
Biographical Notes

Henry Nicola Müller, superintendent of distribution, Duquesne Light Company, Pittsburgh, Pa., was elected president of the Pennsylvania Electric Association at its annual convention last week. Mr Müller was born Nov. 30, 1874, at Steubenville, Ohio, receiving his early education at public schools. He first entered the electrical profession with the Westinghouse Electric & Manufacturing Company and in 1899 joined the old Allegheny County Light Company, where he was placed in charge of electrical repairs and tests. Two years later he was appointed electrician and shortly afterward took active charge of the laboratory of the company. In 1904 he was appointed engineer of tests and later electrical engineer. On the establishment of the present distribution department in Jan. 1, 1910, Mr. Müller was appointed superintendent. Mr. Müller has taken an active interest in association work, and in addition to the N. E. L. A. section of the Duquesne Light Company, in which he takes a prominent part, he is a member of the underground and electrolysis committee of the N. E. L. A. and also of the code committee of the American Institute of Electrical Engineers.

H. N. MÜLLER

Obituary

Dugald G. Porter, general manager of the People's Power Company of Rock Island and Moline, son of Joseph F. Porter, former president of the Tri-City Railway & Light Company, died of typhoid fever at his home in Moline, Iowa, Sept. 1.

John M. Winslow, sixty-one years of age, one of the pioneer telephone builders of the State of Washington, recently died at his country home near Silver Lake, Snohomish County. Mr. Winslow was born in Philadelphia. As a civil engineer he was engaged for a number of years in Mexico. Going to the Pacific Northwest, he settled in Tacoma, and fifteen years ago he went to Seattle to reside. Shortly afterward he purchased an interest in the old Independent Telephone Company in Everett, eventually becoming manager of the concern. When the Independent Telephone Company consolidated with the Puget Sound Telephone Company, operating in Snohomish and Whatcom Counties, Mr. Winslow became secretary-treasurer of the new company. He held this position and was active in the company's affairs up to the day of his death.

Edward H. Johnson, a pioneer in the electrical industry and one of the first presidents of the Edison Electric Light Company, New York, which was founded on Oct. 16, 1878, died on Sunday at his home in New York City in his seventy-second year. For a number of years Mr. Johnson was the personal representative of Thomas A. Edison in a commercial sense. He looked after the financial interests of the Edison companies in the 80's and had considerable influence in the early days of the industry. He was instrumental in interesting the financial interests of the country in electric light properties to the extent that they invested heavily in them. He was always working to extend the service and make it popular with the public. In many ways he was a pioneer. Mr. Johnson was not only one of the founders of the Edison electrical interests of various kinds in this country, but was also a pioneer in a most notable way in regard to the electric power industry and was for many years at the head of the Sprague motor system. He was also an advocate of interior concealed wiring, and his own private house in New York City was the first example of cove lighting. He put into use the first systems of concealed wiring through the Interior Conduit & Cable Company, developing gradually from plain paper to brass and thence to the iron tube which is now so universally in use. It is interesting to note that he was probably the first to light Christmas trees electrically. For a number of years Mr. Johnson was in Europe, where he sought to introduce electric railroading on a large scale. More lately he had taken up the introduction of paper bottles for the delivery of milk and water, in place of glass, believing that this was a development that had become inevitable and necessary.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

COPPER WIRE THE MARKET BAROMETER

General Conditions Underlying Present Demand for Wire, with Certain Indications of Tendencies Now Prevalent

One of the electrical commodities which in normal times are probably the best barometer of business in the electrical industry is copper wire. Wire shows which way the wind blows. If business is good, the demand for wire is proportionate, and vice versa. Besides, if the complexion of the market changes, the sale of wire clearly indicates it.

To-day the market for electrical goods is at its height; never has it been greater. However, the demand is not created by the regular buyers of normal times, but rather by those trades the business of which has been greatly stimulated by war conditions, the industrials. Building operations in most sections have fallen to a minimum. Government operations have been on a large scale.

This is the character of the market for electrical goods and in like manner for wire. Wire is one of the first of the commodities to feel the effect of local conditions. In Chicago, for instance, at the present time the wire market is very uncertain because of the wiremen's strike. Demand is quiet. There is, however, a ray of hope because certain of the contractors have obtained some large contracts and are anxious to begin operations, and it is believed in some quarters that they may effect a compromise.

In neighboring cities in the Middle West, however, where local conditions are better, the wire market is responsive and business is reported as fairly good. In New York, on the other hand, where realty interests find it difficult to obtain money at a satisfactory price, the market is quiet.

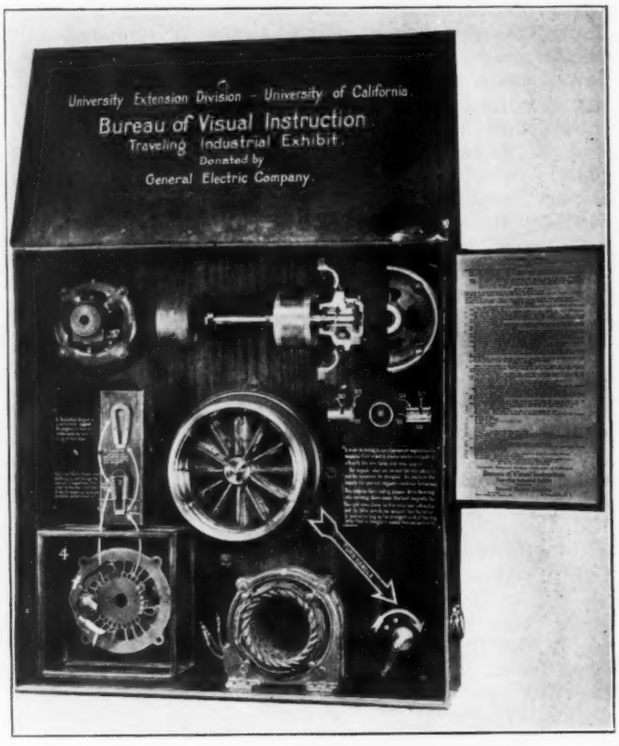
Another indication of the sensitiveness of the wire market is the present condition brought about by the government's hesitation in fixing a price for copper. The wire market is very uneasy, and orders are more of the hand-to-mouth nature. Many contractors are holding off with the belief that copper may be placed at a lower figure and therefore the wire base fall. In this connection it has been hinted that even if wire base does drop a couple of cents the net price of wire will not vary because the discount may be pared sufficiently to make up the difference.

The drop in the cotton market had no apparent effect on insulated wire. For some time it has been pretty generally understood that the big controlling factor in the price of insulated wire was no longer copper. Cotton has had a very important part. However, manufacturers have laid in large stocks of cotton or have contracted for futures at high prices, so that any break in the cotton market makes no impression on insulated wire prices.

UNIVERSITY EXTENSION TRAVELING EXHIBITION

California Institution Has Educational Scheme Which Includes Numerous Products of an Electrical Nature

An educational campaign now under way in California under the direction of the University of California is far-reaching. This university extension scheme provides for the shipping around the State of a collection of educational exhibits among which are many electrical goods. The electrical subjects thus far covered are motors, ranges, lamps, flashlamps, percolators, irons, storage batteries and the telephone. These go to grammar schools from the fifth to the eighth grades, and to night schools to a certain extent. The exhibits have been supplied by various manufacturers and are sent out to be operated by the regular teachers.



ELECTRICAL DISPLAY IN TRAVELING EXHIBITION

There is here shown the electric motor exhibition of the General Electric Company. All of the essential parts are shown, and to one side is a 10-in. by 16.5-in. sheet explaining what a motor is, what it does, how it works and how it is made.

ENGLISH ELECTRICAL MANUFACTURING OUTLOOK

Reorganization Believed to Be Necessary in the Case of Some Very Large Corporations in Great Britain

An outline of the industrial outlook in England, written by Charles H. Haddrell for one of the leading English technical journals, the *Engineer*, makes some rather interesting and perhaps significant remarks about the English electrical manufacturing industry which are quoted in the following paragraphs:

"Electrical manufacturing has never reached a satisfactory position. The majority of British electrical manufacturing companies are financial failures. Reorganizations calling for a writing down of the capital stock or for an assessment of the stockholders have been much too frequent. The remedy is to have fewer manufacturers, and each one to have sufficient strength and resources to be able

to manufacture standardized products and to educate and convince purchasers that he is working for their benefit as well as for his own.

"The electrical manufacturers have been fighting among themselves for the small home market, instead of going out into foreign markets and bringing home the trade of the world. A few powerful firms would be of inestimable value to the country, and a capitalization of from £10,000,000 to £20,000,000 for each would not be excessive. A period of from five to ten years would be required to get such concerns into a good working condition.

"Another instance of the conditions existing in the electrical manufacturing industry will demonstrate that the British manufacturer has not realized the possibilities of the industry. The production of continuous-current motors in Britain is much larger than that of alternating-current induction motors, whereas the contrary should be the case. Considering the world at large, alternating-current apparatus is predominant. All the new power stations of any appreciable size furnish power from alternators, driven either by steam turbines or by waterwheels, and although a certain amount of continuous current is supplied through converter substations, it is considerably more economical to transmit high-tension current and employ step-down transformer substations. The demand for induction motors is already great and will undoubtedly increase very rapidly. South Africa, Australia, Canada and many other countries are growing markets for this class of apparatus.

"The electrical branch of the engineering industry is now of great commercial importance, and it is rapidly becoming more important. It is very unfortunate that there are no electrical manufacturing firms that can rightly be called pre-eminent. There are many small concerns, but none comparable with the leading firms of the world. Some of the leading British firms have not paid a dividend for ten years, and it cannot be expected that capitalists will be interested in such industries."

METAL MARKET CONDITIONS

Copper Stiffens in Price on Sale of Large Tonnage to Allies at 25 Cents

The general tone of the different metal markets is uncertainty. Some metals are stronger this week and others have softened. Lead and aluminum are off, while copper and tin are higher. Copper is from a cent and a quarter to a cent and a half higher than a week ago. This advance is due to the confirmation by the copper committee of the sale of 75,000,000 lb. of copper to the Allies at 25 cents. It is consequently felt that the minimum price to be established by the government will not be less than 25 cents. It was in response to this feeling that copper rose to its present level.

Aside from the sale to the Allies the market has been dull, and normal quotations for electrolytic were as follows on Tuesday: September, 26.37½ cents; October, 26.25 cents; November, 26 cents, and fourth quarter, 26 cents.

NEW YORK METAL MARKET PRICES

	Sept. 4	Sept. 10
Copper:	£ s d	£ s d
London, standard spot	120 0 0	120 0 0
Prime Lake	27.00 to 28.00*	27.00 to 28.00*
Electrolytic	25.50 to 25.75*	26.37½ to 26.62½*
Casting	25.00 to 26.00*	26.25 to 26.50*
Wire base	32.00 to 33.00*	32.00 to 33.00*
Lead, trust price	10.50	10.00
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	19.00	19.00
Spelter, spot	8.05	8.05 to 8.17½
Tin, Straits	61.25	61.50
Aluminum, 98 to 99 per cent.	43.00 to 45.00*	41.50 to 42.50*

OLD METALS

Heavy copper and wire	23.00 to 24.00	24.00 to 25.00
Brass, heavy	15.00 to 16.00	15.50 to 16.50
Brass, light	12.00 to 12.25	12.00 to 12.50
Lead, heavy	9.00 to 9.25	8.25 to 8.50
Zinc, old scrap	5.50 to 6.00	5.50 to 5.75

*Nominal.

THE WEEK IN TRADE

ALTHOUGH local conditions may arise which produce disturbances in the market such as the I. W. W. agitation in the Northwest and the wiremen's strike in Chicago, in general the electrical industry has settled down to a steady business the total volume of which has never before been equaled. Just at present prices are continuing firm. The industry seems to be marking time in this respect. The government's decision regarding basic metals is eagerly awaited, and there are reasons for believing that a favorable price will stimulate certain trades, thereby increasing the demand for electrical staples. Cooking appliances advanced this week. Deliveries seem to be improving, although there may be a setback within the next month due to the movement of troops. Labor conditions show no change, nor does it seem probable that the final calling of the draft men will be very seriously felt, because by that time there will be released for the work many thousands of laborers and mechanics now engaged in cantonment construction,

NEW YORK

Business continues steady with maintained volume. The total demand is large, and both jobbers and manufacturers are very busy. As for the past half year or more, the demand has come from abnormal channels. The building trades, except in the industrials, are quiet. A meeting was set for Thursday afternoon under the auspices of the Building Material Exchange of New York to discover whether there is any fixed reason why building construction should not be permitted to proceed during war time.

There seems to be no doubt that the city is underconstructed. Recent developments point to the present market as the high-water line for prices of building materials, and in fact some materials, of which brick and steel beams and bars are instances, have already softened somewhat.

The contractors and fixture houses are suffering most acutely now from the dearth of new building. Other trades, however, are generally busy, and it is doubtful if deliveries of many of the wiring staples could be had if a large amount of new building were suddenly projected.

IRON CONDUIT.—There is little change in the conduit market. Prices are the same with no indication of a change. The government has taken practically all of the available pipe, and manufacturers' warehouse stocks in the East are reduced to almost nothing.

POLE-LINE HARDWARE.—Much better deliveries are now being obtained on braces, bolts and other similar hardware. Goods cannot be had in three to four weeks.

WALLACE LAMPS.—An advance of 10 per cent was announced for Sept. 10, on account of the cost of raw materials and labor and because of improvements in the base weight of the lamps.

FIXTURES.—Owing to the very small amount of building going on, fixture houses are experiencing very dull times. The number of apartments being built is very small.

WIRE.—On the whole local demand is quiet. What business there is is coming mostly from the industrials. There have been some orders for quite a few thousand feet of No. 14, but the amount represented in dollars and cents has been small. There has been no change in base over last week. Copper softened a bit and cotton broke a good many points, but wire manufacturers were not inclined to make any concessions.

LIGHTING GLASSWARE.—Replacement demand is very strong for new types of glassware. Fixture glass has fallen off owing to the slump in fixture demand. Although there have been a number of price advances lately, it is anticipated that another advance will take place when fires are started for the fall and winter. It is expected that considerable difficulty will then be experienced in obtaining labor and that the cost from this cause wil' be materially increased.

HEATING APPLIANCES.—The new prices go into effect this week. Advances took place on practically all of the

household cooking material. Toasters are now quoted at $5 minimum. One manufacturer put 6-lb. irons up to $5.50. Heating pads also went up. New prices now range from $7.50 to $8.50. There is a steady demand for appliances, principally from jobbers for small customers. Department stores are buying and central stations appear to be well stocked for the present. There has been a call from celluloid manufacturers for hotel griddles to be run on low heat for softening purposes. The recent law prohibited the use of an open flame for this purpose.

DRY BATTERIES.—Local demand is very large. One manufacturing concern reports the largest business it has ever had and that it is impossible to supply batteries fast enough to keep up with consumption. This concern is now two carloads behind in local deliveries. Flashlamp demand has occasioned a large increase in battery output. Prices have not changed since the end of June, nor is any advance expected for the next month at least.

FLASHLAMPS.—Government purchases have materially increased the demand. Every regular soldier has been provided with a flasher, and government orders have been placed in other directions. Besides, the National Guard units now stationed at different concentration camps have been large purchasers of flashlamps. During the last week or ten days a falling off in sales has been noticed, in one case as much as 10 per cent, owing to the close of the vacation period. Prices are the same as they always have been.

CHICAGO

In the Middle West business in some quarters is reported steady, while others say that the last week or two has fallen somewhat behind expectations. Prices remain about the same, except that copper is a little weaker. There is no noticeable change in credits and collections. Industrial business continues to be the most important factor in the market, although it is said that some central stations and telephone companies are purchasing equipment needed to put their lines in shape to withstand the rigors of the coming winter.

The National Bank of the Republic, Chicago, in its "Review of Business" under the date of Sept. 5, has the following to say regarding business in general: "The readjustment of business to a war basis is proving more protracted than was at first anticipated. While business interests generally agree that profit should yield precedence to patriotism, the continued delay in making known the exact extent of governmental price control and taxation has reduced the buying of the country to a hand-to-mouth basis. . . . Thanks to the quiet placing of huge government contracts and to the generous bookings of civilian business of past months, industrial activity shows no diminution. The hardships imposed on manufacturers and merchants by the slow delivery of essential materials and manufactured goods are being gradually eliminated as a result of the supervision exercised by the Railroad War Board over the loading and movement of freight."

WASHING MACHINES.—Every washing machine manufacturer, large and small, is working his plant to the limit of its capacity. Jobbers claim that the washing-machine business is especially good in the Middle West, because jobbers are pushing washing machines harder than they ever did before. Although the washing machine is one of the highest-priced household electric devices, it is enjoying the greatest popularity of all of them just now.

POLE-LINE EQUIPMENT.—There is some buying by companies wishing to put their lines in shape for the winter, but owing to the high prices the fall demand is considered sluggish.

COPPER WIRE.—Some jobbers are selling on a 37-cent base, and some on a 35-cent base. The market looks weak, this tendency being created by the fact that it seems the government will establish a 25-cent base.

ELECTRIC RANGES.—The fact that some business in electric ranges is still being booked appears to strengthen the argument that these devices have passed the stage where the market is entirely a seasonable one.

DRY BATTERIES.—Jobbers report that business in dry batteries is good, in spite of high prices.

INCANDESCENT LAMPS.—Stocks of incandescent lamps, especially in the smaller sizes, are still very low, owing to the inability of factories to meet the demand. The type C lamp, which is needed most in industrial lighting, is much easier to get than the smaller sizes.

BOSTON

Business continues in heavy volume as the fall trade opens in lines of electrical products associated with industrial service. Jobbing interests report a slight falling off of orders in some localities, but the increasing demands of the war are likely soon to offset any reduction in total business so far in sight. This fall the distorting effect of the war upon business is more apparent; some branches of trade are stimulated beyond previous expectations, while others are affected adversely. The time has now come when further postponement of renewals in the street-lighting field cannot be long extended, and business is brisk in reflectors and ornamental poles. Price advances of $1 to $1.50 were scheduled for Sept. 15 on many kinds of electric heating apparatus, but little fear is expressed by the more progressive central stations that the public will fail to absorb this increase without difficulty. Some improvement in inquiries for electric ranges is noted. In most lines of work deliveries are little if any better. The labor situation is improving with the settlement of the strike of Boston & Maine shopmen this week, and the gradual mobilization of drafted men at the cantonments is unquestionably giving employers time to make better adjustments of their organizations than would have been the case had the European methods of assembly been followed. Collections are about the same as last week. Some increase is noted in the wiring of large residences, but new construction in the residential field is still far below normal. The prospects at this writing are rather poor for residential wiring this fall. Motor-driven coal-loading machinery is in great demand.

APPLIANCES.—Business is excellent, despite price increases. Light, portable electric cooking devices are increasing in favor. The trade in heating pads is very promising with respect to early fall, current fuel prices undoubtedly stimulating these.

REFLECTORS.—Street-lighting business is better than last year. Few large jobs are being handled, but replacement orders are numerous and deferred extensions of local service are being completed. Prices are somewhat higher than last year, but there is no indication of any further advance, despite increasing cost of materials and transportation.

VAHEY FAULT LOCATERS.—The Lundin company reports its entire stock sold out, with a brisk demand for these testing sets.

STREET-LIGHTING ORNAMENTAL POLES.—Quotations are being made for immediate use only. Demand is heavy and materials are difficult to obtain on anything like satisfactory deliveries.

FANS.—Movement in fans is very dull, pending the return of a belated warm spell. Some central station buying at costs warranting carrying fans over until next season is reported.

MOTORS.—Diverse reports are in hand as to motor scarcity. Some of the larger central stations maintaining substantial motor stocks appear better satisfied with the situation than for some time. The industrial demand is still very large in volume. On the whole, it appears as though at least a temporary improvement could be recorded in the delivery situation of standard sizes of motors.

WATERWHEEL GOVERNORS.—Deliveries are improving and factory stocks are increasing in this equipment. At present deliveries of governors are on a better basis than of waterwheels. Plants are active in filling orders, but owing to prevailing dullness in new hydroelectric plant construction the outlook for new business is at present rather unsatisfactory. Unquestionably the restrictive policy of the government with respect to water-power development affects

the situation adversely. There is a healthy demand for small waterwheels, but large work is not at present coming forward as it would under proper government policies. Manufacturing interests report serious reductions in their forces due to volunteering and the draft, coincident with the falling off of new business. Prices are high. Proposals have been in great demand during the last four months.

WIRE AND CABLE.—Deliveries are very poor in many lines, compared with normal times. Government orders are very active. Railroad embargoes are impeding industrial movement except in connection with military service.

LAMPS.—The lamp situation is better than a year ago, larger stocks being carried by jobbers and manufacturers. Predictions are unsafe, however, owing to the large numbers of employees of manufacturing plants entering military service, and transportation facilities are such that further restriction may be placed on shipments, with resulting possibility of shortage in the late fall or early winter. It is unlikely that the lamp business of 1917 will show the expansion of a year ago, and it is rumored that the government may soon address central stations, municipal plants and electric railways urging them to decrease the use of light as much as possible for the present.

FLASHLIGHTS.—An excellent vacation trade in this apparatus is reported. Substantial buying for army and navy service is noted.

STEAM PLANT CONDENSING EQUIPMENT.—Demand is very heavy. Deliveries are not improving, and industrial business of quasi-war origin holds the center of the stage. No present signs of improvement are recorded, despite high price levels.

ATLANTA

General business is decidedly good, and practically all factors in the Southeast continue in large volume and high activity. Although labor was scarce and material was high, Atlanta nearly doubled the value of its building operations for August as compared with the same month of last year. The value of building permits for the first eight months of this year as compared with the first eight months of 1916 showed a gain of $1,348,000. There are a number of buildings, mostly of the residential type, being planned in local offices of architects. Work is expected to start on them as soon as cantonment work ceases, easing up on the labor situation and releasing hundreds of skilled laborers.

The Georgia Railway & Power Company expects to complete its single track to Camp Gordon by Oct. 15, and the entire double track by the time the new rotary station is completed near Buckhead. This extension calls for approximately 10 miles of track.

Electrical work at Camp McLellan, Anniston, Ala., was held up temporarily owing to lack of material, but at the present time work is progressing satisfactorily in every direction.

The double track from Montgomery, Ala., to Camp Sheridan for trolley operation will be completed in thirty days, it is reported.

All wiring and electrical installation work at Camp Gordon, Atlanta, is progressing nicely. Contractors report electrical work 70 per cent completed.

TEXTILE MOTORS.—The pressure in this line has almost decreased to a point of dullness. While the erection of a number of new mills is contemplated, there is a good deal of hesitancy with respect to new undertakings, doubtless due to the question of price fixing. Then, too, the uncertainty of the coal situation has effected the central station power business, in that the mechanically driven mills are awaiting new coal prices before purchasing motors at present prices and deliveries.

WIRING SUPPLIES.—Manufacturers report an exceptionally good business for this week. No change in prices has been reported and deliveries remain about the same.

INSULATED WIRE AND CABLE.—The demand is good for nearly all standard sizes of wire, but a slight decrease in inquiries is noted for larger cables. This line has enjoyed a very active year to date; in fact, authentic sources report an increase of 50 per cent for the first eight months of the year as compared with 1916.

LIGHTNING ARRESTERS.—Sales for the Southeast covering the last thirty weeks are away above last year. Normally this line has a steady market, but this year's business has set a new record.

INDUSTRIAL CONTROL EQUIPMENT.—Business continues unusually active and the outlook is decidedly favorable. Sales are running 10 per cent above last year. Deliveries are slowing up.

LARGE APPARATUS.—Manufacturers report a number of inquiries received, but they cannot improve long promises on shipment. A few large deals are pending which will probably be closed very soon.

POLE-LINE MATERIAL.—The call for hardware, glass and porcelain insulators is steady and prices remain firm.

COPPER.—Comparatively firm, but with slight indications of weakness from certain sources.

SEATTLE

Dealers in Seattle and immediate vicinity report no noticeable increase or decrease in sales over last week. Business is satisfactory, considering conditions, which are unsettled in general. No particular line boomed during the week, although the sale of lamps is expected to increase because of the heavy fall rains and the dark days which have started. Some difficulty is being encountered in obtaining and retaining a stock of lamps. Prices along all lines remain steady, with no noticeable increase. Freight conditions are easy, there being no trouble experienced in this connection. Pole and cross-arm dealers are obtaining plenty of poles and cars, but are having serious difficulty in securing and holding crews to do their work. Former fall activity, according to large dealers, will not materialize. Sales do not warrant heavy buying for stocks, and dealers will not load up at top prices. Enough will be purchased to fill demand, which will increase somewhat when mills and logging camps resume full operations. No decrease in demand is anticipated. Any change will be upward. Building is at a standstill, with no indications of resumption in Seattle. Portland reports building operations for August 50 per cent less than for August last year. It is believed that this ratio in most cases will apply to nearly every city in the Northwest, with the exception of Spokane.

Credits and collections are satisfactory. The week saw a general resumption in lumber cutting throughout the State, according to mill and camp operators. Labor organizations on strike deny this, and say that the strike is all but won. Some mills, however, are running on a ten-hour basis, and the market has visibly stiffened. The failure of lumber manufacturers to deliver their orders to the Alaska Railway Commission may result in delaying construction of the line.

CONDUIT.—Demand from shipyards is steady, with indications of an increase when protected yards begin operations. Prices are firm.

HOUSEHOLD APPLIANCES.—It is believed that the demand will increase materially with the closing of the summer season. Certain large dealers will push sales on some lines.

INDUSTRIAL EQUIPMENT.—Demand for motors, wire, cable and the like will increase at the end of the present lumber difficulty.

SAN FRANCISCO

Business in general was very good last week, industrial demands being particularly active. Demands for heating appliances continue to show improvement. Orders for electric ranges from the country and from suburban towns show a noticeable increase, though city trade is light. Washing-machine demand continues to improve, probably owing to lack of household help, which has created an active demand for electrical appliances to lessen the burden of service. Business in flashlights is good owing to their use by soldiers in the various encampments and to the fact that they are sent by friends to soldiers who have already left the city. Small dealers are carrying good stocks of socket devices and are prepared to take care of present and future needs. Collections show a steady improvement right along.

Current Prices of Electrical Supplies

NEW YORK AND CHICAGO QUOTATIONS

The prices quoted are those prevailing in standard packages or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists to contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers.

The variation in prices may be due to the difference in grade of products made by different manufacturers, to local conditions, or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List, per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 solid:	
Less than coil	$54.90 to $61.00
Coil to 1000 ft	48.80 to 59.17
No. 12 solid:	
Less than coil	63.90 to 71.00
Coil to 1000 ft	56.80 to 68.87

Twin-Conductor

No. 14 solid:	
Less than coil	$78.00 to $104.00
Coil to 1000 ft	75.00 to 80.00
No. 12 solid:	
Less than coil	121.50 to 135.00
Coil to 1000 ft	108.00 to 130.95

DISCOUNT—CHICAGO

Single-Conductor

Less than coil	+10%
Coil to 1000 ft	—10%

Twin-Conductor

Less than coil	+10%
Coil to 1000 ft	—10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	—10% to 12%
1/5 to std. pkg	10% to 20%
Std. pkg.	34% to 44%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to 12%
1/5 to std. pkg	Net to 20%
Std. pkg.	30% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28	.29

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 30	.35	.35
50 to barrel	.3175	.3275
Barrel lots	.2875	.2975

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$67.50 to $75.00	$60.00 to $69.75
3/8-in. double strip	71.75 to 75.00	63.75 to 72.00
1/2-in. single strip	90.00 to 100.00	80.00 to 93.00
1/2-in. double strip	95.00 to 100.00	85.00 to 96.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 100 Ft.
3/4-in. single strip	$75.00	$63.75
3/4-in. double strip	78.75	71.25
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	85.00-95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size. In.	List per Foot	Size. In.	List per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$55.00	$24.50-$25.50	$21.50-$24.75
1/4-in.—	$40.00-$60.00	$27.00-$30.00	$23.50-$27.00

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$36.65 to $55.00	$27.50	$23.10-$24.75
1/4-in.—	$40.00 to $60.00	$30.00	$25.20-27.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37
2 1/2	.58 1/2
3	.76 1/2

	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.60
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	6% to 8%	8% to 10%
2500 to 5000 lb.	9% to 11%	11% to 13%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	3.8% to 8%	5.8% to 10%
2500-5000 lb.	6.8% to 11%	8.8% to 13%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

Net	$3.50

CHICAGO

Net	$3.75 to $4.20

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.75 to $6.30
1/5 to std. pkg.	4.50 to 5.25

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

	Std. Pkg.	List, Each
Regular, clear:		
10 to 40-watt—B	100	$0.27
60-watt—B	100	.36
100-watt—B	24	.65
75-watt—C	50	.65
100-watt—C	24	1.00
200-watt—C	24	2.00
300-watt—C	24	3.00
Round bulbs, 3¼ in., frosted:		
15-watt—G 25	50	.50
25-watt—G 25	50	.50
40-watt—G 25	50	.50
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.72
Round bulbs, 4⅝ in., frosted:		
100-watt—G 35	24	1.05

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00 to $34.88
Coil to 1000 ft.	21.00 to 26.52

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$37.20
Coil to 1000 ft.	27.90

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100	$15.00 to $29.00

CHICAGO

Net per 100	$14.58 to $34.00

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, AX. 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	List to 33%	List to 27%
$10.00 to $50.00 list	List to 42%	37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$14.00 to $20.00
1/5 to std. pkg.	13.00 to 15.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80 to $20.54
1/5 to std. pkg.	14.80 to 19.24

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$10.50 to $18.00	$28.00
1/5 to std. pkg.	9.75 to 11.10	21.50

CHICAGO

Per 1000 Net	Std. Pkg. 3500 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 std. pkg.	11.10	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
¼-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15% to 20%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%

SWITCHES, KNIFE

250-Volt, Front Connections, No. Fuse

	List
High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

High Grade:	
Less than $10 list	List to —5%
$10 to $25 list	11% to 16%
$25 to $50 list	14% to 24%
Low Grade:	
Less than $10.00 list	5% to —5%
$10.00 to $25.00 list	11% to 16%
$25.00 to $50.00 list	14% to 24%

DISCOUNT—CHICAGO

Less than $10 list	+5% to 5%
$10 to $25 list	11% to 16%
$25 to $50 list	14% to 24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp., three-point	100	.54
10-amp., three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to Net
1/5 to std. pkg.	Net to 15%
Std. pkg.	30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar	List, Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List to 23%	18%
$2.00 to $10.00 list	20% to 23%	18%
$10.00 to $50.00 list	23% to 30%	18%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25% to 50%	20% to 40%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

Net price	$3.10 to $3.50

CHICAGO

Net price	$3.50 to $4.50

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

No. 18, less than full spools	$0.52
No. 18, full spools	0.48

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.065 to $0.6885
No. 18, full spools	0.5285 to 0.56

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00-18.00	$12.00-14.50	$11.50-12.50
12	21.06-28.35	18.96-24.30	18.01-20.25
10	29.60-39.53	26.64-34.14	25.31-28.45
8	42.40-56.49	38.16-48.42	36.25-40.35
6	72.19-89.39	64.98-76.62	61.73-63.85

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00	$16.00	$14.00
12	25.99-28.63	21.96-24.54	20.13-22.50
10	36.49-40.28	30.84-34.44	28.27-31.57
8	48.84-51.83	43.80-44.77	40.15-44.77
6	70.24-81.93	63.85-69.24	56.54-57.47

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$40.25 to $45.00
25 to 50 lb.	39.25 to 42.00
50 to 100 lb.	38.00 to 38.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	4185 to 45.50
25 to 50 lb.	40.85 to 44.50
50 to 100 lb.	39.85 to 43.50

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

One-Piece Ground Clamps

Ground clamps made entirely of copper and in one piece are manufactured by the H. B. Sherman Company of Battle Creek, Mich. The roll portion for soldering is turned in to rest against the opposite end of the clamp, preventing the ends from tipping together when tightened, holding the gears parallel and assuring the largest amount of drawing power. A screwdriver is the only tool necessary for the application of this clamp, which is made in three sizes.

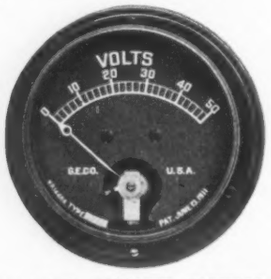
Radial-Flow Fan

The Green Fuel Economizer Company of New York City has developed for direct connection to steam turbines for motors a fan known as the radial-flow fan. The design of this fan is much along centrifugal pump lines and is such that the path of the air or gases through the fan has the least resistance consistent with ease of manufacture and results in efficiency that is far above that usually met with in fans for forced and induced-draft service, it is claimed.

This fan lends itself to direct connection to alternating current motors at the higher synchronous speeds, which enables use to be made of small and compact driving units. These fans are also applicable to induced-draft and various types of exhaust service, particularly mine ventilation, where the higher pressures are desirable.

Miniature Meters for Commercial Circuits

The General Electric Company has developed round voltmeters and ammeters 2¼-in. (5.2-cm.) in diameter which give accurate readings on direct-current circuits ranging from 10 volts to 150 volts and 10 amp. to 150 amp., respectively, it is claimed. These instruments, known as type DM, utilize the D'Arsonval permanent magnet moving-coil principle. The voltmeters have self-contained resistance and the ammeters have self-contained shunts up to 40 amp. Extremely light-weight moving elements are used with hardened polished points and jeweled bearings. The zero adjustment is made by a small screw in front at the base of the instrument.



PERMANENT MAGNET MOVING COIL PRINCIPLE USED

In order to obtain complete and permanent insulation all parts of the measuring element are mounted on a bakelite base. The scale and mechanism are protected from foreign substance by a drawn brass cover carrying a round glass dial. For convenience in reading, a metal scale plate is used with black background and white needle and scale markings. All instruments are back-connected for front of board mounting.

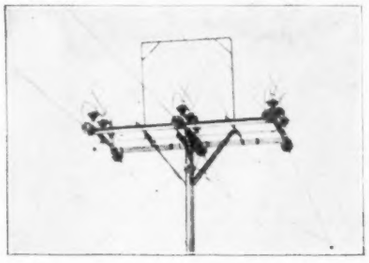
Electric Coffee Urn Heater

An electric coffee urn heater that has an adjustable base so that the burner may be raised to meet the bottom of the urn has been developed by the Hughes Electric Heating Company, 5660 West Taylor Street, Chicago. This heater is made in three sizes, 880 watts, 1100 watts and 1500 watts, and is furnished with a three-heat switch. The maximum height is 10 in. (25.4 cm.) and the minimum height 6 in. (15.2 cm.). It has a black enamel stand and a gunmetal-finish switch. This heater is equipped with a surface burner composed of coils of resistance wire securely fastened in the grooves of a high heat-resisting composition plate which in turn fits snugly in a special thick, heavy asbestos composition receptacle. The resistance wire is drawn from a composition of 80 per cent nickel and 20 per cent cronium. The wire coils are not harmed by liquid boiling over on them, it is claimed.

PHANTOM VIEW OF COFFEE URN AND HEATER

Air-Brake Switch with Rack for Ground Wire

The accompanying illustration shows a method employed by the Delta-Star Electric Company of Chicago for mounting its standard three-pole type "PM" 33,000-volt, 200-amp. air-break switch on a Bates expanded steel transmission pole. To enable carrying an overhead ground wire straight through the line, the cross-arms are provided with an auxiliary rack to which is fastened the overhead ground wire. The switch is provided with a manually operated remote-control interlocked mechanism, enabling all three poles to be simultaneously opened or closed by means of a locking-type handle. When desired the operating shaft can be extended so that the switch handle is near ground level. The complete switching, cross-arm and pole equipment is shipped ready for immediate assembly, thus reducing cost.



GROUND WIRE IS FASTENED ON RACK

Electric Vulcanizer

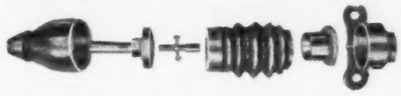
An electric vulcanizer that has only two parts has been placed on the market by the Premier Electric Company of Chicago, Ill. The two parts consist of a heating disk with a long flexible cord and plug to fit any light socket on an automobile and a clamp to hold the disk in position. It is claimed that this vulcanizer will make a patch in ten minutes.

Split Porcelain Knob

The Findlay Electric Porcelain Company of Findlay, Ohio, has developed an interchangeable knob which interlocks and cannot get out of alignment either while being installed or afterward, it is claimed. It is pointed out that all the pieces are just alike. The breaking of one section does not destroy a whole knob. The wire grooves are deep and hold the wire perfectly without injuring the installation, it is said.

Disconnecting Pot-Heads

Disconnecting pot-heads that consist of three distinct parts—base, body and top—are made by the Electrical Development & Machine Company of Philadelphia. The metal base has in-



SCREW-CONTACT DISCONNECTING POT-HEAD

corporated in it a standard sheath clamp and static protection member. The body, which attaches to the metal base, is of porcelain or metal. For single-conductor pot-heads porcelain bodies are generally used, while metal is standard construction for multiple-conductor types.

The outlet tube or bushing for any one type of pot-head is the same design for one, two, three or four conductors. The fluting, length of tube, etc., vary, however, with the potential requirements of service. This outlet tube is sealed at the top with a watertight cap, which in turn is covered by a porcelain cap, so that whether in service or disconnected the pot-head is protected against the entrance of any moisture, it is said.

In addition to the porcelain cap, a small composition cap is supplied as a covering for the bare disconnecting terminal, which partly protrudes above the porcelain cap. This composition cap is taped to the outgoing wire and thus affords an easy method of disconnection without danger of water leaking into the pot-head top.

Non-Raveling Tape

To meet the scarcity of woven tapes for insulating purposes a cambric tape has been developed by Freydberg Brothers, Inc., New York City, which has a fast edge even though it is not woven. A special process in making this tape is used which prevents the edges from unraveling. The tape is said to have the same mechanical and electrical properties as the woven tape, and it is somewhat cheaper to manufacture. It can be made in any desired width, and while it can be secured in several thicknesses, 6 mil. (0.24 in.) is the thickness most generally used.

Outdoor Switch-House Construction

A very open type of outdoor switch-house construction, which, it is claimed, provides the maximum of accessibility, has recently been brought out by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. In switch houses of this description the oil circuit breaker is mounted on a specially constructed bracket and the meters are mounted on a slate slab. The bracket is so designed that it will take different sizes of breakers.

This method of mounting the circuit breaker has the advantage of being easily accessible for the inspection of wiring, removal of oil tanks, inspection of contacts and replacement of fuses protecting the voltage transformers.

A ground-mounted switch house with panel-mounting circuit breaker has also been developed. The circuit breaker and instruments are all mounted on one slate slab, and while the construction is not so open as with the bracket-mounted breaker, it has a very neat and pleasing appearance.

Control Panels for Printing Presses

The Igranic Electric Company, Ltd., of 147 Queen Victoria Street, London, England, has developed a standard panel which for reciprocating and small rotary printing presses contains all the apparatus that is necessary for the control of the press by push buttons.

All of the apparatus is inclosed in an iron housing with hinged glazed door on the front, the housing being fitted with lugs so as to permit of its

CONTROL PANEL FOR MOUNTING ON PILLARS OR WALL

being easily bolted to the wall. The handle of the double-pole isolating switch is external to the housing and is so interlocked with the door that the latter cannot be opened unless the isolating switch has first been opened, and conversely the isolating switch cannot be closed unless the door has first been closed. The operating handle of the speed-regulating rheostat projects through the front of the cover in a convenient position, and beneath this handle is a small window through which may be seen a figure indicating the position of the regulating lever.

Bench Conduit Bender

The Henderson Electric Company of Ampere, N. J., is making a one-piece conduit bender designed to be mounted on a post or installed flat on a bench. Any combination of bends and offsets may be made with this device, the manufacturer points out, without kinking or flattening. Three sizes are made to handle ½-in., ¾-in. and 1-in. (1.27-cm., 1.9-cm. and 2.54-cm.) conduit respectively. The Western distributer of the bender is M. B. Austin & Company, 700-710 Jackson Boulevard, Chicago.

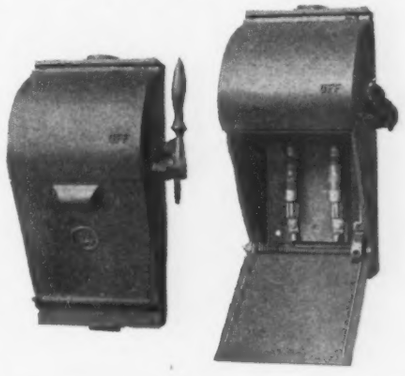
Electric Vacuum Cleaner

An electric vacuum cleaner provided with a convenient snap switch on the handle is announced by the Hurley Machine Company, Clinton and Monroe Streets, Chicago. A rubber comb is used on the floor piece, and the manufacturer calls attention to the fact that this feature enables the machine to pick up hair, threads, ravelings and all other surface dirt. This nozzle may be raised or lowered to suit the conditions of operation. Special attachments are made for cleaning moldings, portières, walls, mattresses and upholstery. The motor is mounted so that the axis of its shaft is horizontal. The body of the machine is of steel, welded into a solid piece. The construction is rugged, yet the cleaner weighs less than 9 lb. (4.1 kg.).

Switch with Live Parts Totally Inclosed

The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has brought out a switch which consists of an ordinary single-throw knife switch and inclosed fuse holders mounted in a strong cast-iron box, with an operating handle outside the housing. The box is designed for conduit connection and has a partition separating the switch blades from the fuse holders.

The upper or switch compartment can be opened only by removing two machine screws. The lower or fuse compartment, containing the fuses and fuse holders, is the only part of the switch that need be opened, and then only to replace blown fuses. The door of this compartment is so interlocked with the switch by a vertically acting push rod which engages a boss on the



SWITCH CANNOT BE CLOSED WHEN DOOR IS OPEN

fuse-compartment door that it can be opened only when the operating handle is in the off position and the circuit broken. Furthermore, with the door of this compartment open it is impossible to close the switch.

Trade Notes

JOHN B. PRICE, district manager for the Mechanical Appliance Company of Milwaukee, has opened an office at 515 Mercantile Library Building, Cincinnati, for that company.

PHILIP VALK, purchasing agent for Schuurman & DeJong, Amsterdam, Holland, and the Holland-Bombay Trading Company, Ltd., Amsterdam, has moved to 309 Broadway, New York City.

SAMUEL SWETT, manufacturers' agent, importer and exporter, 149 Broadway, New York City, states that he has recently been appointed the exclusive agent in the United States for George Cradock & Company, Ltd., of Wakefield, England, manufacturers of wire and wire rope.

THE CURRAN SIGN COMPANY, Spokane, Wash., specialist in electric signs, plans to extend its business field to include the entire Spokane district and is placing salesmen in the field. The company now does a heavy business in Montana, where it has representatives.

THE NATIONAL LAMP WORKS, through George H. Johnson, architect, have filed plans with the city building department at Cleveland, Ohio, for a warehouse for the works, to be built at 1131 East 152d Street. It will be 145 ft. by 266 ft. in dimensions and cost $160,000.

THE WESTINGHOUSE LAMP COMPANY, 165 Broadway, New York, is making rapid progress in the construction of its new plant on Pennington Avenue, Trenton, N. J., and plans for the immediate installation of equipment. The company expects to commence operations at the new works in the near future.

J. F. PORTER, formerly president of the Tri-City Railway & Light Company, Davenport, Iowa, is the new head of the Kansas City (Mo.) Light & Power Company. Mr. Porter succeeds John H. Lucas, who had been president of the company since its reorganization and separation from the railway company.

THE CLEVELAND SWITCHBOARD COMPANY, Cleveland, Ohio, having lost its plant through the destruction by fire of the building in which it was located, has purchased a site on East Seventy-ninth Street, just south of the Cleveland & Youngstown Railroad, where a new factory will be erected. The loss of the company by the fire is estimated at about $20,000.

THE BRYANT ELECTRIC COMPANY of Bridgeport, Conn., announces the appointment of George H. Williams, formerly New York representative of Gillinder & Sons Company, to take charge of its New York office, 51 East Forty-second Street. Mr. Williams takes the place of Robert Abbott, who as a member of the Roosevelt hospital unit is now in France.

THE PEERLESS INTERNATIONAL CORPORATION, 50 Pine Street, New York City, has been organized to conduct an export, import and general engineering and contracting business, with the following officers and board of directors: Alfonse Kaufman, president; Simon Weiner, vice-president; F. A. Beardsley, secretary; William M. Blain, treasurer; Walter W Birge, president Air Reduction Company, and L. K. Comstock, president L. K. Comstock & Company.

MEETING OF GEAR MANUFACTURERS' ASSOCIATION.—A meeting of the American Gear Manufacturers' Association was held at the Edgewater Beach Hotel, Chicago, Ill., Sept. 14 and 15. Papers on the following subjects were presented: "Advertising Don'ts," "Heat Treating and Hardening of Gears," "Inspection of Gearing," "Spur Gearing by the Rotary or Disk Cutting Process," and "Spur Gears by the Shaper Method." F. W. Sinram is president of the association, H. E. Eberhardt vice-president, F. D. Hamlin secretary, and Frank Horsburgh treasurer.

GRAY & BARASH COMPANY, Inc., has leased an entire block at Horton Avenue and Colorado Street, Seattle, Wash., on which a plant will be immediately erected. The company is swamped with orders for electrical machinery and equipment for the many new vessels either under construction or about to be built. The company has occupied a store at First Avenue South and Jackson Street for fourteen years, but the business on hand necessitates expansion. There are enough orders ahead to keep the proposed new plant running for a long period. The company recently closed contract for supplying equipment for a new paper mill, in addition to a number of recent orders for ship equipment.

J. MILTON AYER has resigned from the engineering staff of the Boston (Mass.) Elevated Railway to become treasurer of the Day Baker Motor Truck Company of Boston. Mr. Ayer was closely associated with the development of the rapid-transit system of the Boston company, following a term of service in a central station heating organization. He was educated at the University of Maine and at Harvard University, and for some years has been actively engaged in investigations for executive officials. In his new work he will be associated with the development of the New England agency for the C. W. Hunt Company's products, including the Hunt industrial electric truck and conveying machinery, the Atlantic electric truck and the Hurlburt gasoline truck.

Trade Publications

VACUUM CLEANERS.—The Hurley Machine Company of Chicago is distributing a leaflet descriptive of its Thor No. 5 vacuum cleaner.

RANGES.—The Standard Electric Stove Company of Toledo, Ohio, is distributing a calendar for September and a folder descriptive of its electric range.

FLOODLIGHTING PROJECTORS.—The George Cutter Company of South Bend, Ind., has issued two bulletins descriptive of its universal floodlighting projectors.

FORCED-DRAFT APPARATUS.—The B. F. Sturtevant Company of Hyde Park, Boston, Mass., has prepared catalog No. 236, descriptive of its steel-plate fans, multivane fans and turbovane fans.

SWITCHES.—The Arrow Electric Company of Hartford, Conn., has prepared a bulletin describing electrotypes this company is furnishing for advertising purposes. The list includes information on pull switches, standard duplex receptacles, electrolier push-button switches, current taps, pull socket attachments and lock sockets.

STORAGE BATTERIES.—Bulletin No. 610, descriptive of Edison storage batteries in lumber transportation, has been prepared by the Edison Storage Battery Company, Orange, N. J. These batteries are for use with lumber tractors, industrial locomotives and surface carriers. Illustrations of actual installations are given, together with a description of the battery.

STEAM TURBINES.—Single-stage and multi-stage steam turbines and reduction gears are illustrated and described in bulletin No. 3, published by the Moore Steam Turbine Corporation of Wellsville, N. Y. This bulletin discusses the present status of single-stage steam turbines, multi-stage turbines, standardized methods of manufacture, and construction of this type of turbine as made by this company.

PUMPS.—The Worthington Pump & Machinery Corporation, 115 Broadway, New York City, is distributing bulletin W-600-A, descriptive of its Worthington volute centrifugal pumps. The purpose of this catalog is to illustrate and describe the different types of volute pumps manufactured by Henry R. Worthington, to set forth the advantages of each, and to give such information as will be of interest to the prospective purchaser and operator. The Worthington turbine pumps are described in another catalog which this company has prepared.

WATER PIPE.—Michigan combination steel and wood water pipe is illustrated and described in a bulletin prepared by the Michigan Pipe Company of Bay City, Mich. This book gives in a concise, straightforward manner facts that are of interest to consulting engineers, superintendents, engineers of water works and others having liquids of any nature to convey. Various tables on water supply and other technical data which by actual experience have been found valuable on account both of their scope and their convenient form are given. The bulletin is well illustrated and has been carefully prepared.

PORTABLE ELEVATOR.—Bulletin No. 43, entitled "The Steel Giant," is a twenty-page booklet just issued by the New York Revolving Portable Elevator Company, Jersey City, N. J., which describes the unusual uses in which their "revolvator," sometimes nicknamed "the Steel Giant," has been employed. Among these may be mentioned the erecting of overhead motors and taking them down for repairs, erecting and repairing overhead shafting, overhead drilling, whereby a man and a portable drilling outfit may be quickly and safely elevated to the place in which the drilling is to be done; loading heavy cases and bales from sidewalks onto trucks; loading freight into cars, piling goods inside freight cars, storing sheet iron, elevating heavy dies to presses, etc.

New Incorporations

THE GUARANTY ELECTRIC WORKS, Burley, Idaho, have filed articles of incorporation with a capital stock of $5,000.

THE SHANER ELECTRIC COMPANY, McKeesport, Pa., has been incorporated by F. H. Emerson, with a capital stock of $10,000.

THE ILLUMINAL CORPORATION, New York, has been organized by Sachary Werschansky, Richard E. Berthod and G. Suss with a capital stock of $10,000.

THE DEARBORN ELECTRIC LIGHT & POWER COMPANY, Dearborn, Mo., has been organized by W. H. Gabbert, Morris Putlick and R. H. Bruce. The company is capitalized at $5,000.

THE GRAND RIVER HYDROELECTRIC COMPANY, Tulsa, Okla., has been organized by H. C. Holderman, C. H. Fenstermacher and J. H. Rothammer. It is capitalized at $10,000.

THE JACKSON LIGHT & ICE COMPANY, Jackson, Ky., has been incorporated by A. H. Hargis, J. S. Redwine and L. Hays, Jr., with a capital of $12,000. The company will operate a local lighting plant.

THE IROQUOIS PUBLIC SERVICE CORPORATION, Syracuse, N. Y., has been incorporated, with a capital of $1,500,000, by L. S. Chapman, Robert Love, Martin G. Grossman and A. S. Ellis of Syracuse.

THE AMBOY LIGHTING COMPANY, Perth Amboy, N. J., has been incorporated, with a capital of $15,000, by S. and E. Hyman and Morris Weinstein. The company proposes to engage in a local electrical business.

THE EASTERN CONNECTICUT POWER COMPANY, Hartford, Conn., has been organized by Robert W. Perkins of Norwich for the purpose of selling and manufacturing electricity. The capital stock of the company is $1,000,000.

THE MODERN ELECTRIC LAMP COMPANY, INC., New York, has been organized for the purpose of selling electrical fixtures. The company is capitalized at $3,000 and has been organized by Elias Tauber, Joseph Goldstone and George R. Rubin.

THE STAMFORD ELECTRIC & MANUFACTURING COMPANY, Stamford, Conn., has been organized by Edward Heitman and Edith B. Heitman of Stamford and Andrew Baile and John D. Baile of Montreal. The company is capitalized at $50,100.

THE SUPERIOR ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has been incorporated with a capital stock of $10,000. The incorporators are Walter W. Tangeman, Frank W. Willey, Harry P. Mefford, Charles L. Tangeman and Fred J. Wray.

THE HAMTRAMCK LIGHT COMPANY, Hamtramck, Mich., has been incorporated to sell electrical supplies. The company has been incorporated by Max J. Kogan of Hamtramck, Maurice Schlussel and Mark Sugarman of Detroit. The company is capitalized at $5,000.

THE ALABAMA STORAGE BATTERY COMPANY, Birmingham, Ala., has been incorporated with a capital stock of $6,000. The officers of the company are: H. W. Matthews, president; Fred Sintes, vice-president, and C. R. Matthews, secretary-treasurer.

THE TIFFANY NEVER-WIND CLOCK CORPORATION, Buffalo, N. Y., has been incorporated with a capital stock of $150,000. The incorporators are F. N. Gunnison, I. L. Kisk and W. C. Newcomb, all of Buffalo. It is proposed to manufacture electric clocks.

THE BAY RIDGE ELECTRICAL COMPANY of Brooklyn, N. Y., has been incorporated by D. F. McDonald, A. M. Stagg and J. F. Warner, 1466 Nicholas Avenue. The company is capitalized at $5,000, and proposes to deal in automobiles, motor vehicles and do a general motor business.

THE AUTOMATIC STRAIGHT AIR BRAKE COMPANY, New York, has been organized with a capital stock of $5,000,000. The officers of the company are: H. I. Miller, president; K. B. Conger, vice-president and treasurer; A. M. Trueb, secretary and auditor; G. C. Pierce, chief engineer, and S. C. Neale, consulting engineer.

THE AUTOMATIC CONTROLLER & MANUFACTURING COMPANY, Salt Lake City, Utah, has been incorporated for the purpose of manufacturing electrical appliances. The officers of the company are: Cleveland Redfield, president; J. W. O'Brien, vice-president; Thomas L. Whitehill, treasurer; William J. Stone, secretary. The company is capitalized at $100,000.

New England States

BROWNVILLE, ME.—The Brownville Electric Light & Power Company has petitioned the Public Utilities Commission for permission to issue $5,000 in capital stock, the proceeds to be used for extensions to plant and system.

LAKE VIEW, ME.—The Lake View Electric Company has petitioned the Public Service Commission for permission to issue $3,000 in capital stock.

RANGELEY, ME.—The electric plant of the Oquossoc Light & Power Company was recently destroyed by fire.

VAN BUREN, ME.—The Public Service Commission has authorized the Van Buren Light and Power District to issue $35,000 in bonds, the proceeds to be used for the purchase of the property of the Van Buren Light & Power Company and for extensions and improvements.

BOSTON, MASS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Sept. 28 for furnishing and installing interior lighting fixtures in the United States appraisers' stores at Boston, Mass. Drawings and specifications may be obtained at the above office.

PITTSFIELD, MASS.—Work has begun on the addition to the power plant of the Pittsfield Electric Company, which, with equipment, will cost about $300,000. The output of the plant will be increased by 2500 kw.

PROVIDENCE, R. I.—An underground conduit along Second and Brow Streets is being installed by the Narragansett Electric Lighting Company which will carry the high-tension transmission line which now extends across the Watchemoket section from the power station south of Mauran Avenue to Red Bridge. The line supplies energy to the mills in Phillipsdale.

NEW LONDON, CONN.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Sept. 24 for construction of two buildings for officers' quarters, including electric-lighting and heating system, at the submarine base at New London, Conn.

PLAINVILLE, CONN.—The Trumbull Electric Company is building an addition, 50 ft. by 100 ft., four stories, to its plant, which will give it a total space of 110,000 sq. ft.

Middle Atlantic States

BINGHAMTON, N. Y.—Orders have been placed by the Binghamton Railway Company for two new generators, to cost about $40,000.

BROOKLYN, N. Y.—The Atlantic Avenue Business Men's Association has petitioned the Department of Water, Gas and Electricity to replace the gas lamps now in use with electric lamps.

BROOKLYN, N. Y.—Plans are being prepared by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for additions to hydraulic plants of the structural and machine shops at the Navy Yard, Brooklyn, to cost about $75,000.

BROOKLYN, N. Y.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Sept. 18 for furnishing distilling plants and motor-driven potato peelers at the navy yard, Brooklyn, N. Y. Proposal blanks may be obtained on application to the above bureau or to the supply officer, navy yard, Brooklyn, N. Y.

BROOKLYN, N. Y.—Bids will be received by the New York Municipal Railway Corporation, 85 Clinton Street, Brooklyn, until Oct. 1, for the construction of trainmen's building, signal towers, circuit breaker houses and additional platforms and control facilities in connection with the Coney Island terminal. Plans and further information may be obtained upon application to office of the chief engineer, 85 Clinton Street, Brooklyn.

BUFFALO, N. Y.—Ground has been broken for an addition to the plant of the Ericsson Manufacturing Company to increase its facilities for manufacturing the Berling magneto. The company manufactures shop telephones, magnetos and other electrical apparatus.

NEW HAMPTON, N. Y.—The contract for the construction of the new power house at New Hampton Farms has been awarded to Nielsen & Miller of Middletown.

THIELLS, N. Y.—Bids will be received by Frank A. Vanderlip, president of the board of managers of Letchworth Village, 7 Wall Street, New York City, until Sept. 28 for construction of additional central heating plant; building eight cottages (I, J, K, L, M, N, O and P), assembly hall and industrial building, including heating, plumbing and electric work, at Letchworth Village, Thiells. Drawings and specifications may be consulted at Letchworth Village, at the office of board of managers, 7 Wall Street, New York City; at the New York office of the Department of Architecture, Room 1224, Woolworth Building, and at the Department of Architecture, Capitol, Albany. Lewis F. Pilcher is state architect.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

THIELLS, N. Y.—Bids will be received by Frank A. Vanderlip, president of the board of managers of Letchworth Village, 7 Wall Street, New York, until Oct. 5 for construction, heating, plumbing and electric work for Attendants' Home and Service Building; heating work, underground piping and conduit; plumbing work, underground sewer and water connections; electric work and underground conduits; construction work of bridge across creek at Letchworth Village, Thiells. Specifications may be seen at Letchworth Village, Thiells, at the office of the board of managers, 7 Wall Street, New York City, at the New York office of the Department of Architecture, Room 1224, Woolworth Building, New York City, and at the Department of Architecture, Albany. Lewis F. Pilcher is state architect.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., has petitioned the Public Service Commission to issue $198,700 in capital stock and $477,000 in bonds, the proceeds to be used for the completion of an electric transmission line from Natural Bridge to South Edwards and for reimbursement of the company's treasury.

AMPERE, N. J.—The Crocker-Wheeler Company is reported to be planning to erect a five-story reinforced-concrete plant, 100 ft. by 200 ft., at Fourth Avenue and Twelfth Street, to cost about $163,000. The company has also acquired the plant of Edward Maher's Sons, iron founders, 216 Berlin Street, Newark, which it will enlarge and improve.

BAYONNE, N. J.—The Public Service Electric Company has submitted a proposal to the City Commission for the installation of a temporary arc lamp system on lower Broadway, instead of the ornamental lighting system to be installed in accordance with the contract with the city. The company agrees to install the ornamental system during the coming year. About $20,000 will be expended for street-lighting improvements.

CAMDEN, N. J.—Contract has been awarded by the Department of Public Property of Camden for the erection of a machine shop, 38 ft. by 110 ft., one-story high, at Fifth and Arch Streets, for municipal work.

WOODSTOWN, N. J.—The Borough Council has awarded a contract to the Electric Company of New Jersey to furnish electricity for the waterworks. The five-year lighting contract, which has just expired, will be renewed.

CHALFONT, PA.—The Borough Council is considering establishing an electric-lighting system in Chalfont. It is proposed to secure energy from the Lansdale plant if possible.

COATESVILLE, PA.—A franchise has been granted to Paul S. Stansbury to construct and operate an electric railway from the business section of the city to Honeybrook and vicinity to furnish service to the iron and steel works, about 2 miles distant.

CONEMAUGH, PA.—The Borough Council has decided to close down the municipal electric generating plant and purchase energy to operate the local system from the Citizens' Light, Heat & Power Company of Johnstown. A three-year contract with the Citizens' company is reported to be under consideration.

PHILADELPHIA, PA.—The Penn Chemical Company is reported to be erecting a new power station, at a cost of about $35,000.

PHILADELPHIA, PA.—The Public Service Commission has granted the Suburban Gas & Electric Company permission to issue $168,000 in bonds, the proceeds to be used for expansion of system.

POTTSTOWN, PA.—Plans are being considered by the Pottstown & Phoenixville Railway Company for extending its electric railway from Linfield to Spring City, a distance of about 21 miles.

READING, PA.—A franchise has been granted the Reading Transit & Light Company to construct and operate a single-track railway along Canal Street, south of Chestnut Street.

WILMINGTON, DEL.—The Wilmington & Philadelphia Traction Company is planning to construct an addition, 54 ft. by 64 ft., to its plant at Eighteenth and Buena Vista Streets, to cost approximately $55,000.

BALTIMORE, MD.—Work has begun by the United Railways & Electric Company on the installation of automatic electric signals on its railway to Sparrows Point and Bay Shore Park, including 54 stations.

ASHLAND, W. VA.—The installation of a new ornamental street-lighting system, to cost about $15,000, is under consideration by the City Council.

WHEELING, W. VA.—Bids will be received at the United States Engineer office, Wheeling, W. Va., until Oct. 2 for construction of a fireproof power house at Dam No. 24, Ohio River.

NORFOLK, VA.—Contract has been awarded by the United States government for the erection of power plant for the United States naval base at the site of the Jamestown Exposition to J. W. Danforth Company of Norfolk. The contract calls for erection of plant and distribution system, with exception of boilers.

WASHINGTON, D. C.—The power house of the Washington & Old Dominion Railway Company at Roslyn will be closed down and energy to operate the system will be purchased from the Potomac Electric Company.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Sept. 17 for jet condensers and pumping equipments at various yards. Specifications (No. 2546) can be obtained on application to the above bureau.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Sept. 28 for furnishing and installing interior lighting fixtures in the United States appraisers' stores at Boston, Mass. For details see Searchlight Section.

WASHINGTON, D. C.—Plans are being prepared for the Bureau of Yards and Docks, Washington, D. C., for a new five-story pattern shop, six-story machine shop, steel forging works and brass foundry, with other structures, to be erected at the navy yards on the Atlantic Coast. F. R. Harris is chief of bureau.

WASHINGTON, D. C.—Recommendations for public improvements in Columbia Heights have been filed with the Commissioners of the District of Columbia by J. Clinton Hiatt, secretary of the Columbia Heights Citizens' Association, which include improvements to lighting system on a number of streets, removal of trolley poles along Georgia Avenue north of Florida Avenue, new street signs, etc.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Philadelphia, Pa., Schedule 1472—6000 detonators (electric and combination fuse and electric) for use with trinitrotoluol. Brooklyn, N. Y., Schedule 1471—30 motor-driven potato peelers and spare parts. Boston, Mass., Schedule 1474—miscellaneous ammeters (switchboard type), miscellaneous blocks, cartridge type fuse, etc., brackets (bronze finish), 10,000 hard rubber insulating bushings, 100 Bosch spark coil buttons, 550 rubber ear cushions, miscellaneous igniters, magnetos, fittings, etc. Washington, D. C., Schedule 1473—two geared head lathes, 14 in. by 6 ft. bed, motor attached; three motor-driven single-spindle boring machines, two motor-driven, single spindle, vertical boring machines, one each motor-driven rod and dowel machines, Nos. 2, 4 and 5; Schedule 1467—one motor-driven key-seating machine. Las Animas, Col., Schedule 1459—one motor-driven cutting and pipe threading machine. Application for proposals should designate the schedule desired by number.

North Central States

HOLLY, MICH.—The installation of electrically operated pumps at the waterworks pumping station is under consideration by the City Council, at a cost of about $15,000. It is proposed to install two pumps at present, but eventually five pumps will be installed.

NASHVILLE, MICH.—The installation of an ornamental lighting system is under consideration.

PORTLAND, MICH.—The Village Board has appropriated the sum of $3,200 for the installation of a new ornamental lighting system in the business section, to cost about $3,200.

ST. JOHNS, MICH.—The Board of Public Works has been authorized to purchase a 10-in. electrically operated rotary pump to replace the present steam pump at the pumping station, to cost about $2,000.

AKRON, OHIO.—The contract for street-lighting expires on Oct. 4, 1917. The city, it is announced, will engage an expert engineer to aid in making the new contract. The cost of the present system is $50,000 for incandescent lamps and $13,000 for arc lamps per year.

BLUFFTON, OHIO.—Bonds to the amount of $35,000 have been sold, the proceeds to be used for reconstruction of the municipal electric-light plant and water-works system.

CANTON, OHIO.—The Canton & Ohio River Railways Company, recently organized with a capital stock of $10,000, contemplates the construction of an interurban railway from Canton to Wheeling, a distance of 105 miles.

CLEVELAND, OHIO.—Bids will be received at the office of purchases and supplies, City Hall, Cleveland, until Sept. 21 for structural steel work for the division of light and heat. Specifications may be obtained on application to the office of the division of light and heat.

MADISONVILLE, OHIO.—The City Council has decided to close down the municipal electric-light plant. Electrical service will be supplied by the Union Gas & Electric Company of Cincinnati.

MIDDLETOWN, OHIO.—Arrangements are being made for the installation of an ornamental lighting system on Michigan Boulevard, a suburb of Middletown.

YOUNGSTOWN, OHIO.—The Republic Railway & Light Company, it is reported, is securing a right of way for the erection of a high-tension transmission line through the southwest section of the city.

JENKINS, KY.—The Consolidated Coal Company, it is reported, is interested in the construction of an electric railway in Jenkins, to connect with Burdine, Dunham, East Jenkins, McRoberts, Fleming and Haymond.

OWENSBORO, KY.—The Owensboro City Railroad Company is planning to build several miles of additional street railway lines, connecting with important suburbs.

RIDGE FARM, ILL.—Steps have been taken to organize a company to build an electric line between Clinton and Ridge Farm. For further information address John W. Foster, Ridge Farm.

MANITOWOC, WIS.—The capital stock of the Green Bay & Eastern Railway Company has been increased from $50,000 to $3,000,000. The company is contemplating the construction of an electric railway from Manitowoc to Green Bay, thence to Sheboygan, a distance of 70 miles.

MARINETTE, WIS.—The Brown Mitcheson Company, it is reported, is building a large addition to its electric plant.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company has recently placed a contract with the Locomotive Pulverized Fuel Company, 30 Church Street, New York, N. Y., to equip the 2500-hp. boilers at its Oneida Street plant with apparatus for the burning of pulverized coal.

OSHKOSH, WIS.—The capital stock of the Universal Motor Company has been increased from $25,000 to $50,000, the proceeds to be used to double the output of electric-lighting units designed especially for army field service.

WAUWATOSA, WIS.—The construction of a central power plant to furnish electricity for lamps and motors to all the county institutions is reported to be under consideration. F. C. Phelps of Milwaukee is county clerk.

DONNELLY, MINN.—The question of issuing $14,000 in bonds for the construction of a municipal electric-light and power plant in Donnelly is under consideration.

RICE, MINN.—Bids will be received by D. I. Bouch, village clerk, until Sept. 21 for construction of an electric transmission line and distribution system for the village of Rice. Plans and specifications are on file in the office of the village clerk and in the office of Earl D. Jackson, consulting engineer, Capital Bank Building, St. Paul, Minn.

RICE, MINN.—Bonds to the amount of $8,000 have been voted for the erection of an electric transmission line from Little Falls to Royalton. Energy to operate the local system will be supplied by the Royalton Power & Light Company, which secures its supply from the Little Falls (Minn.) Power Company. Earl Jackson of St. Paul is consulting engineer.

ST. PAUL, MINN.—A proposal to replace the gasoline lamps now in use on the Mississippi River Boulevard from Summit Avenue to Fort Snelling with electric lamps has been submitted to the City Council by Commissioner Keller.

ST. PAUL, MINN.—Plans are being considered by the City Council for the installation of ornamental lamps on all the important highways of the city. The extension plans for 1917 provide for the erection of 459 additional lamps. Other ordinances calling for the installation of 1506 more ornamental lamps are under consideration by the Council.

CEDAR RAPIDS, IOWA.—The Iowa Railway & Light Company of Cedar Rapids has been granted a franchise by the Board of Railroad Commissioners to erect and maintain electric transmission lines on certain roads and highways in Greene County.

CRESCO, IOWA.—Bids will be received by B. F. Davis, secretary of board of education of the independent school district of Cresco, Cresco, until Oct. 3 for the construction of a grade school building and a vocational school building, including general construction, heating and ventilating, plumbing and electric work. Copies of plans may be obtained at the office of G. L. Lockhart, Endicott Building, St. Paul, Minn.

DES MOINES, IOWA.—The erection of 250 additional electroliers in the metropolitan lighting district is under consideration.

HUMBOLDT, IOWA.—The Board of Railroad Commissioners has granted the Northern Iowa Gas & Electric Company of Humboldt permission to erect and maintain electric transmission lines on certain roads and highways in Humboldt County. The company has also been granted a franchise to erect electric transmission lines on certain roads and highways in Wright County.

INDIANOLA, IOWA.—Bids will be received by the city of Indianola until Oct. 1 for furnishing and installing three triplex, motor-driven pumps, electric control equipment for motors, transformers, motor-generator set and three-panel switchboard. For details see Searchlight Department.

SAC CITY, IOWA.—At an election held recently the proposal to issue $60,000 in bonds for the installation of an electric-light and power plant was carried.

SUTHERLAND, IOWA.—Plans are being prepared for the construction of a telephone building for the Sutherland Telephone Company, to cost about $25,000. Bids for construction of building, it is understood, will soon be asked for. H. L. Eddington is manager.

KANSAS CITY, MO.—The Wyandotte County Commissioners have refused to grant the Kansas City Railways Company the privilege to erect cables on the new Central Avenue viaduct to connect the Kaw River power house with the power plant at Second Street and Grand Avenue.

DUNN CENTER, N. D.—The local municipal electric-light plant has been taken over by the Dunn Equity Elevator Company, which will operate the plant, using excess power at its elevator.

CHADRON, NEB.—Both the lighting and telegraph companies are removing poles from the principal business streets, prior to the installation of the proposed new electrolier lighting system that is to be installed in the business section of the city.,

WESTERN, NEB.—Bonds to the amount of $10,000 have been voted for the installation of an electric-lighting system.

ANDALE, KAN.—The installation of an electric-light plant and ice factory in Andale is reported to be under consideration by the Otto Weiss Company.

AUGUSTA, KAN.—Extensions and improvements are being made to the municipal electric-light plant, including the installation of new electric generators and additional pumps.

BARNES, KAN.—The installation of an electric-lighting system in Barnes is under consideration.

CANEY, KAN.—The property of the Caney Electric Light & Railway Company has been taken over by the Kansas Light & Power Company, recently organized by H. A. Carmichael of Duluth, Minn., and others. The present plant will be rebuilt and additional machinery installed.

GREAT BEND, KAN.—The contract for electric wiring for the new court house at Great Bend has been awarded to the Cates Electric Company. The cost of the building is estimated at $190,000.

GRENOLA, KAN.—Bonds to the amount of $15,000 have been voted for improvements to the municipal electric-lighting system. W. B. Rollins, Railway Exchange, Kansas City, Mo., is engineer.

HOE, KAN.—The Council has passed an ordinance granting a franchise to the Riverside Light, Power & Gas Company to furnish electricity for lamps, heat and motors in Hoe.

SAWYER, KAN.—The installation of a municipal electric-light plant in Sawyer is under consideration.

Southern States

RICH SQUARE, N. C.—Improvements are contemplated to the plant of the Rich Square Light & Power Company, including the installation of a crude-oil engine. Equipment, it is understood, has been purchased.

STOVALL, N. C.—Samuel C. Howard, it is reported, is planning to construct a dam and install hydroelectric plant and to build a corn mill in Stovall.

MARIETTA, GA.—Arrangements are being made by the Glover Machine Works for the construction of a new steel foundry and forge shop. The plans provide for the installation of a new electric furnace.

PALMETTO, GA.—Plans are being considered for the installation of electric equipment at the Palmetto Cotton Mills.

SAVANNAH, GA.—Work has begun on the foundations for the new electric plant at the marine training camp at Paris Island.

KEY WEST, FLA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Sept. 28 for a refrigerating plant in the United States Marine Hospital at Key West. Copies of specifications may be obtained at the above office or at the office of the custodian at Key West.

JEFFERSON CITY, TENN.—The local electric-light plant, owned by John J. Lawrence, has been sold to Mr. Goughnour of Newport. Improvements to the plant and system are contemplated by the new owner.

MEMPHIS, TENN.—Bids will be received at the office of the Mississippi River Commission, First and Second Districts, Custom House, Memphis, until Sept. 26 for furnishing one boiler feed pump, feed water heater, centrifugal sand pump, engines and single drum hoist. Further information may be obtained on application to the above office.

NASHVILLE, TENN.—The construction of a new power house at the Fisk University is under consideration.

ANNISTON, ALA.—The Southern Bell Telephone & Telegraph Company has authorized an expenditure of $75,000 for improvements in connection with the proposed extension to Camp McClellan, which will include the installation of additional section of switchboards in the Anniston exchange. The company is installing an exchange at the camp to which 125 telephones will be connected. The work will also include the erection of 35,000 ft. of cable and over 150 miles of open wire.

MOBILE, ALA.—The Kelly-Atkinson Construction Company of Chicago, Ill., it is reported, will build a power plant in connection with its proposed new shipbuilding plant on a site recently acquired in Mobile.

MONTGOMERY, ALA.—The Montgomery Light & Traction Company is contemplating the construction of a substation equipped with five rotary converters with accessories.

FERNWOOD, MISS.—Work is progressing rapidly on the construction of the power plant of the McComb-Magnolia Light & Railway Company in Fernwood. This plant will supply energy to operate the car line from McComb City to Magnolia, a distance of 7 miles, as well as for lighting both cities. The electric generating plants at Magnolia and McComb City will both be closed down upon completion of the local plant.

HATTIESBURG, MISS.—Lighting service and electricity for pumping water at the military camp at Hattiesburg will be supplied by the Hattiesburg Traction Company.

TUPELO, MISS.—Bids, it is reported, are being received by the Tupelo Elevator Company for elevator and grist-mill machinery and power plant equipment for a daily capacity of 40,000 bushels.

ALEXANDRIA, LA.—The contract for the installation of electrical equipment at the army cantonment now under construction at Alexandria, has been awarded to the Interstate Electric Company.

DE RIDDER, LA.—Preparations are being made to rebuild the electric-light plant of the De Ridder Light & Power Company, at a cost of about $10,000. A power house, 72 ft. by 36 ft., will be erected and new equipment, including a 150-kw., three-phase, 60-cycle generator and engine, directly connected, and switchboard will be installed.

Machinery, it is understood, has not been purchased.

WESTWEGO, LA.—Steps, it is reported, have been taken by Leo. A. Marrero of Gretna to organize a company to construct and operate an electric-light plant and water-works system in Westwego.

ADDINGTON, OKLA.—At an election to be held on Sept. 20 the proposal to issue $5,000 in bonds for the installation of an electric-lighting system will be submitted to the voters.

BEAVER CITY, OKLA.—Approval has been given to the $8,000 bond issue, recently voted for the installation of a municipal electric-light plant. Bids for construction of plant, it is understood, will soon be asked.

HENRYETTA, OKLA.—The Henryetta-Dewar-Kusa Traction Company has been granted a franchise to construct and operate an electric railway to connect Henryetta and Kusa. Bonds have been voted and about two miles of rails laid. J. J. Harrison is general manager.

MIAMI, OKLA.—Improvements, involving an expenditure of $150,000, are contemplated to the municipal electric-light plant and water-works system.

WAUKOMIS, OKLA.—The local municipal electric-light and power plant, it is reported, has been purchased by the Central Light & Power Company. The system will soon be taken over by the company, which will establish a 24-hour service, securing energy from the transmission line from the Enid plant.

BELLS, TEX.—The Texas Power & Light Company, it is reported, is contemplating the construction of a substation here and the erection of a high-tension transmission line from Bells to Whitewright.

HOUSTON, TEX.—The Houston Electric Company has been granted a franchise to build an extension to Camp Logan.

MARFA, TEX.—The property of the Marfa Electric Light & Ice Company has been purchased by Morrison & McCall of St. Louis, Mo. The new owners, it is said, will install additional machinery and greatly increase the output of the plant.

Pacific and Mountain States

ARLINGTON, WASH.—The auxiliary steam plant of the Coast Utilities Company serving Arlington with electricity for lamps and motors was recently damaged by fire. Machinery, including boiler, engine, generator, motors, pump, switchboard, etc., were damaged. Arrangements are being made to rebuild the plant and install new equipment at once.

EVERETT, WASH.—The United States Government has refused to grant the application of the city of Everett for a site on the Sultan River within the Forest Reserve. Reported in the issue of Sept. 8 that the City Commissioners had closed a site on the Horseshoe Bend on the Sultan River.

PROSSER, WASH.—The Prosser Light & Power Company has applied for a 50-year franchise to operate in Prosser.

SEATTLE, WASH.—Bids are being received by the secretary of the Port Commission for the installation of electric-light and power systems in the new annex to the grain elevator.

SEATTLE, WASH.—The Puget Sound Pulp & Power Company, recently organized with a capital stock of $16,000,000, contemplates the construction of a paper mill and power plant in the Puget Sound district.

SEDRO WOOLLEY, WASH.—Bids submitted for boilers for the power house at the State Insane Asylum near Sedro Woolley have been rejected as too high. New bids will be asked for. George W. Lawton, Alaska Building, Seattle, Wash., is architect.

ASHLAND, ORE.—The large concrete dam of the California-Oregon Power Company at Copco is reported to be nearing completion. The initial installation will provide for a development of 50,000 hp.

PORTLAND, ORE.—The Interstate Bridge Commission has decided to install a new motor-generator set to furnish energy to operate the span of the Interstate Bridge. The cost is estimated at $5,250.

SUMPTER, ORE.—The electric plant of the Sumpter Light & Water Company, it is reported, will be rebuilt at once.

ARCATA, CAL.—The Western States Electric Company of Eureka, it is reported, contemplates rebuilding its entire local system.

BLYTHE, CAL.—A franchise has been granted to the Southern Sierras Power Company of Riverside to construct and operate an electric-light plant in Blythe for a period of 50 years. Plans are under way for the construction of the proposed plant.

FRESNO, CAL.—The State Railroad Commission has granted the San Joaquin Light & Power Company permission to sell $745,000 in bonds, the proceeds to be used for extensions and improvements to its system.

FRESNO, CAL.—The distillery, engine house and equipment, and power plant, etc., of the St. George winery, located about 3 miles from Fresno, was recently destroyed by fire, causing a loss of between $50,000 and $60,000.

GILROY, CAL.—The State Railroad Commission has granted the Coast Counties Gas & Electric Company permission to operate in Gilroy under a franchise granted by the city. The Counties Coast Company has leased the local system for a period of ten years.

LOS ANGELES, CAL.—A permit has been granted by the city of Los Angeles to Los Angeles County to erect a power house, tunnel and stack at 1126 Mission Road, to cost about $38,500.

LOS ANGELES, CAL.—Bids will be received by the Board of Supervisors of Los Angeles County, Los Angeles, until Sept. 24 for the construction of power house and tunnel at the County Hospital in the city of Los Angeles. H. J. Lelande is county clerk.

LOS ANGELES, CAL.—Plans are being prepared by the Bureau of Architecture for a power plant to be erected at the Ingleside Jail, to cost about $15,000. The station will also house a central heating system. Bids will be asked for construction of same as soon as plans are completed.

LOS ANGELES, CAL.—Negotiations, it is said, are under way by the Edison Electric Company of Los Angeles for the purchase of the Shaver Lake power site from Ira Bennett. The company, it is stated, contemplates the development at that site. With the diversion of the waters of Pittman Creek into the Shaver basin, it is estimated that 45,000 kw. could be developed.

OAKLAND, CAL.—The erection of new lamp standards and appliances on North Broadway is under consideration.

RIALTO, CAL.—The Fontana (Cal.) Power Company is planning to construct a new hydroelectric power plant in Lytle Creek Canyon, near Rialto. The plans provide for an initial capacity of 15,000 kw. McKeen & Miller, Monadnock Block, Chicago, Ill., are engineers.

SACRAMENTO, CAL.—Plans have been filed with the City Commission by Thomas Coulter, commissioner of public works, for a new electrically driven pump to be installed at the city pumping plant.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company has been awarded a contract to furnish Camp Fremont with electricity. Work has begun at the camp, where substations are being erected, rights of way secured, etc.

SAN FRANCISCO, CAL.—The Great Western Power Company has completed a high-tension transmission line from Las Plumas to Veramount station. The line will supply energy to mines in the vicinity of Crescent Mills, including the Philadelphia Exploration Company's holdings, Crescent Mine and Green Mountain. It will also serve as an auxiliary for Engle's copper mine during the winter months. The line may be extended later through Genesee to supply electricity to the Walker Copper Mine.

SAN JOSE, CAL.—The State Railroad Commission of California has authorized the San Jose Railroads and the Peninsular Railway Company to transfer to the Pacific Gas & Electric Company an electric transmission line, including poles, wires, etc., right of way of the two railroads from San Jose to Saratoga, also the stationary motor system of the railroads in Santa Clara County, for $62,500. The companies are authorized to execute a contract for the sale of electric energy.

WATSONVILLE, CAL.—The Coast Counties Gas & Electric Company has submitted a proposal to the city of Watsonville offering to install 142 new street lamps, consisting of 80 80-watt lamps, 37 100-watt lamps and 25 250-watt lamps, at a cost of about $5,000.

ABERDEEN, IDAHO.—The Idaho Power Company, it is reported, is contemplating extending its system into the outlying districts 4 or 5 miles north of Aberdeen.

RIRIE, IDAHO.—Application has been made to the Public Utilities Commission by the town of Ririe asking that the Utah Light & Power Company be compelled to extend its service lines into Ririe.

AJO, ARIZ.—Plans are being prepared by the New Cornelia Copper Company for a smelting plant of 2000 tons daily capacity, to cost approximately $1,500,000, and an oil flotation plant of about 5000 tons capacity. Extensive electrical equipment will be required for these installations, including motor drives for flotation plant. The company has recently placed its 5000-ton copper leaching plant in operation.

GLOBE, ARIZ.—Application has been made to the Corporation Commission by W. W. Shenk of Globe for permission to organize a company to construct a hydroelectric power plant on the Colorado River to supply energy to operate electric railways.

HARLEM, MONT.—The contract for the pole line and switchboard, including commercial and lighting circuits, has been awarded to the Electric Construction Company of St. Paul, Minn., at $10,490. The Fairbanks-Morse Company was awarded contract for equipment, at $9,380.

TROY, MONT.—The Council has granted a franchise to William B. McDonald to install and operate an electric-light plant in Troy. A. P. Tills is local representative.

DENVER, COL.—A new Curtis steam turbine is being installed at the Platte Street power station of the Denver Tramway Company. The engines will, with one or two exceptions, be retained as a duplicate source of power in case of emergencies.

TEXICO, N. M.—The State Line Utilities Company, recently incorporated with a capital stock of $30,000, is planning to construct and operate an electric-light plant in Texico for the purpose of supplying electricity here and to other towns in this section.

Canada

OLDS, ALTA.—The Olds Electric Company, recently incorporated with a capital stock of $20,000, is planning to install an electric-light plant.

LONDON, ONT.—Plans have been approved by the Ontario Railway and Municipal Board for the proposed additions to the London Street Railway.

OSHAWA, ONT.—The erection of an electric transmission line from Lindsay to Oshawa, for auxiliary service, is under consideration by the Ontario Hydro-Electric Power Commission.

PICTON, ONT.—The Hydro-Electric by-laws recently voted on by the municipalities of Picton, Wellington and Bloomfield were carried.

TORONTO, ONT.—The Canadian National Carbon Company is contemplating the construction of a power house.

TORONTO, ONT.—The directors of the Canadian National Exhibit, it is reported, are considering the construction of an auxiliary electric power plant in the near future.

CEDARS, QUE.—The Unit Construction Company, Guaranty Building, St. Louis, Mo., it is reported, has been engaged to design and construct an addition, 600 ft. by 130 ft., to the power plant of the Cedars Rapids hydroelectric development at Cedars, to cost about $250,000.

THREE RIVERS, QUE.—Plans are being prepared by the Shawinigan Water & Power Company of Shawinigan Falls for a clearance conductor span, 5000 ft. long, over the St. Lawrence River at Three Rivers, for the transmission of electricity which will supplement the submarine cable already installed.

THREE RIVERS, QUE.—Preparations are being made by the Three Rivers Shipyard Company for the construction of a new shipyard, to cost about $125,000. The company is reported to be in the market for a 15-ton electric crane; 15-hp. to 75-hp. electric motor; a large B.C. fir lumber band saw working at angle; a 16-in. planer; air compressor or blocker.

LUMSDEN, SASK.—The Council is considering the purchase of the local electric-light plant, to be owned and operated by the municipality.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing agent, the Panama Canal, Washington, D. C., until Oct. 1, for electric wire, fans, fixtures, bells and fittings, steel angles and plates, etc. Blanks and further information relating to this circular (No. 1168) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New

York City; Audubon Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

PANAMA.—Bids will be received at the office of the purchasing officer of the Panama Canal, Washington, D. C., until Sept. 25 for an incinerating plant, marine boiler fittings and auxiliaries, generating set, gasoline motor, steel plates, gas engine, etc. Blanks and further information relating to this circular (No. 1167) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Audubon Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

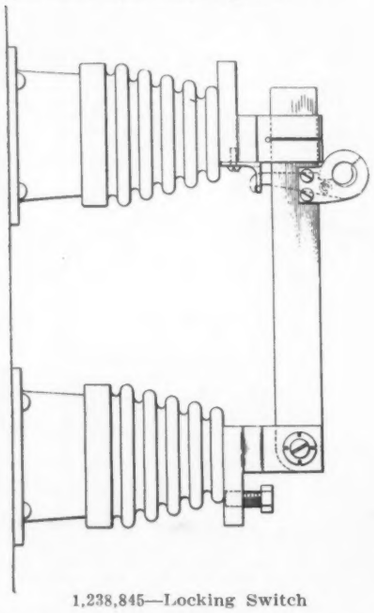
MADRAS, INDIA.—The United States consul at Madras, India, writes that Best & Company (an English firm at Madras) has applied to the government of Madras for a license to supply electrical energy under the Indian electricity act within the municipality of the town of Madura for lamps and motors. A street-lighting system is to be established in at least 36 streets. The town of Madura is situated 344 miles south of Madras on the main railroad to Ceylon, and has a population of about 134,130. For further information address Best & Company, Ltd., First Line Beach, Madras, India.

Record of Electrical Patents

Notes on United States Patents issued on September 4, 1917

1,238,755. SECONDARY OR STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed Feb. 3, 1915. Improvements.

1,238,768. INSULATOR; Gregory C. Hill, Victor, N. Y. App. filed March 3, 1917. Improved construction in which a durable locking element is provided which may be positioned between the members of the insulator after the insulator members have been fitted together.



1,238,845—Locking Switch

1,238,776. THERMOSTATIC TRIP-SWITCH DEVICE; Jesse Jackson, Kokomo, Ind. App. filed Sept. 24, 1915. For electric stoves and ovens.

1,238,792. ELECTRIC HOT PLATE OR HEAT UNIT; Maurice E. Louth and Jesse Jackson, Kokomo, Ind. App. filed July 28, 1915. Means of utilizing the maximum of the heat developed.

1,238,793. ELECTRIC HEAT-STORAGE HEATING UNIT; Maurice E. Louth and Jesse Jackson, Kokomo, Ind. App. filed Sept. 13, 1915. Has a number of interchangeable sub-units which are easily removable and replaceable.

1,238,799. CONNECTOR FOR FLEXIBLE ARMORED CONDUCTORS; Louis Marchand, Jr., Pittsburgh, Pa. App. filed Jan. 30, 1915. Improvements.

1,238,845. LOCKING SWITCH; Peder C. Thoner, Everett, Mass. App. filed Oct. 30, 1914. Adapted for high-voltage circuits.

1,238,850. PORTABLE ELECTRIC LIGHT; George W. Wacker. Rutherford, N. J. App. filed April 2, 1916. Tubular.

1,238,868. ELECTRIC LIGHTING APPARATUS; Charles Wirt, Philadelphia, Pa. App. filed Jan. 5, 1915. Improvements.

1,238,869. AUTOMATIC REGULATOR FOR COMBINED DYNAMO AND STORAGE-BATTERY CIRCUITS; Albert E. Doman, Elbridge, N. Y. App. filed Sept. 9, 1911. Improvements.

1,238,885. JUNCTION BOX; Albert Chmela, Newark, N. J. App. filed Jan. 26, 1916. Adapted to be opened and inspected easily.

1,238,923. DYNAMO-ELECTRIC MACHINE; Carlton L. Kennedy, South Braintree, Mass. App. filed April 5, 1916. Such as are used in the transmission of ether-wave signals or for any purpose where an unusually high frequency is requisite.

1,238,949. SEPARATING DEVICE; Montgomery Sleeth, Bellevue, Pa. App. filed Jan. 28, 1916. Relates to magnetic devices for separating extraneous metallic articles from bulk cotton or the like.

1,238,975. SIGNALING APPARATUS; Henry R. Worthington, Dunnfield, N. J. App. filed Feb. 26, 1910. Provides means which in times of fog, rain or snow will enable officers in command of ships to give definite information to every one in their vicinity as to the position of their ships and the direction in which they are moving.

1,239,005. INCANDESCENT-LAMP-ATTACHING MEMBER; Arthur L. Harris and Eugene F. Casanova, San Francisco, Cal. App. filed May 10, 1916. May be secured to a pocket without being screwed into engagement therewith.

1,239,008. ELECTROMAGNETIC WINDING; Clark T. Henderson, Milwaukee, Wis. App. filed July 6, 1914. May be readily and thoroughly impregnated.

1,239,012. ELECTROLYTIC CELL; Noak V. Hybinette, Christiania, Norway. App. filed May 22, 1913. Means for use in the electrolytic deposition of copper from solutions containing iron and copper.

1,239,019. WRAPPING MACHINE; Nafew J. Lloyd, Butte, Mont. App. filed Dec. 5, 1914. Article being wrapped is automatically fed in position for receiving the wrapping material.

1,239,054. ELECTRIC PUSH-BUTTON; William Sparks, Jackson, Mich. App. filed April 25, 1913. Improvements.

1,239,056. ELECTRIC MOTOR; William Sparks, Jackson, Mich. App. filed Sept. 11, 1914. For electrically operated horns.

1,239,062. LOCKING SWITCH; Peder C. Thoner, Everett, Mass. App. filed Dec. 2, 1916. For high-voltage circuits.

1,239,078. FLASHLIGHT; Bernard Benedict, New York City, N. Y. App. filed Nov. 19, 1915. Pocket.

1,239,140. FIRE-ALARM APPARATUS; Alberto Torchio, Oyster Bay, N. Y. App. filed Jan. 12, 1917. Improvements.

1,239,141. ELECTRIC SIGNALING APPARATUS; Frank S. Tucker, Boston, Mass. App. filed April 25, 1913. Improvements.

1,239,145. X-RAY APPARATUS; Julius B. Wantz, Chicago, Ill. App. filed Jan. 29, 1914. Relates also to the supporting of a fluorescent viewing screen for use in connection with the X-ray tube.

1,239,146. X-RAY TABLE; Julius B. Wantz, Chicago, Ill. App. filed Feb. 16, 1914. Improved.

1,239,178. PROCESS FOR OBTAINING ALKALI-EARTH METALS; William M. Grosvenor, Ridgewood, N. J. App. filed Feb. 3, 1916. Particularly adapted to the obtaining of metallic magnesium.

1,239,182. MOUNTING SHELL FOR INCANDESCENT ELECTRIC LAMPS; Edwin W. Hender, Watertown, Conn. App. filed March 29, 1917. For ceiling or side-wall lighting.

1,239,199. SWITCH LOCK; Benjamin H. McNeil, Chicago, Ill. App. filed March 17, 1917. For attachment to motor vehicles to prevent the theft or unauthorized use thereof.

1,239,214. ELECTRIC FURNACE; Edgar F. Price, Port Chester, N. Y. App. filed Feb. 1, 1917. Hearth constitutes one of the furnace electrodes or circuit terminals.

1,239,215. ELECTRIC FURNACE; Edgar F. Price, Port Chester, N. Y. App. filed Feb. 1, 1917. Provision of a novel and durable form of electrical connection for a movable electrode of such furnaces.

1,239,243. HOLE PLUG FOR JUNCTION BOXES AND SIMILAR STRUCTURES; Charles Wuensch, St. Louis, Mo. App. filed April 21, 1916. Improvement.

1,239,249. RECTIFIER FOR ALTERNATING CURRENTS; Edwin C. Ballman, Kirkwood, Mo. App. filed Aug. 6, 1914. Vibrating type.

1,239,257. ELECTRICALLY HEATED SEAM RUBBER; Edwin N. Chandler, Braintree, Mass. App. filed May 3, 1917. For use in connection with boots and shoes.

1,239,275. CONTROL SWITCH FOR ELECTRIC LAMPS; Eliot Keen, Brooklyn, N. Y. App. filed Aug. 4, 1915. In appearance and mode of operation it resembles the conventional wall push switch.

1,239,317. LAMP SOCKET; George B. Thomas, Bridgeport, Conn. App. filed April 6, 1916. Improved.

1,239,320. APPARATUS FOR DETECTING SUBAQUEOUS SOUNDS; Francois Van Esbroeck, London, England. App. filed July 31, 1916. Designed to discover the presence in the vicinity of a submarine or submersible vessel by the vibrations from its screw propellers.

1,239,322. ELECTRIC THERMAL CUT-OUT DEVICE; Louis Vecchio, Albany, N. Y. App. filed Dec. 9, 1916. Capable of being placed in position as a unitary element.

1,239,325. ELECTRIC WATER HEATER; Ernest C. Webster, Oakland, Cal. App. filed Sept. 18, 1915. Improvements.

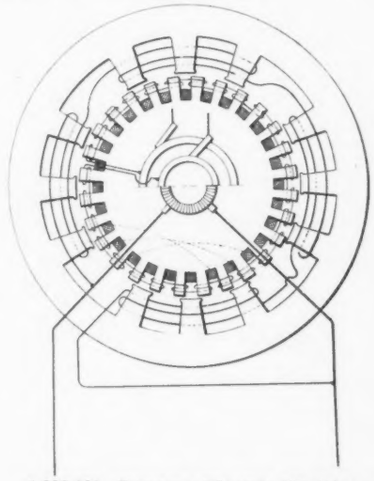
1,239,339. MAXIMUM-DEMAND INDICATOR; John T. Beechlyn, Lynn, Mass. App. filed Nov. 11, 1913. Movable member is maintained in the position to which it has been moved when the consumption of energy in the installation is interrupted, and is not returned to its initial position until the interval of measurement is fully completed after the consumption of energy has been resumed.

1,239,344. ELECTRICAL GUN; Levi M. Bowman and William A. Smith, Tulsa, Okla. App. filed May 29, 1917. Primary object of the invention is to provide a gun which may be made safe from accidental discharge, and after having once been sighted the pulling of the trigger to fire the gun will not pull the gun off from the object sighted at.

1,239,357. RELAY; Hiram D. Currier and Lawrence Ericson, Chicago, Ill. App. filed Oct. 9, 1915. For use in connection with telephone apparatus.

1,239,381. SIGNALING SYSTEM; John C. Francis, Canton, Mass. App. filed July 12, 1916. Fire alarm.

1,239,383. FIRE AND RAIN ALARM; George M. Gebhard, Rochester, N. Y. App. filed Feb. 16, 1916. Improvements.



1,238,923—Dynamo-Electric Machine

1,239,410. CABLE CONSTRUCTION; Ernest B. Livy, Richmond, Va. App. filed Nov. 17, 1916. Provides for the filling of these cables by the use of a material which is strong and durable, virtually weatherproof and waterproof, and a good dielectric.

1,239,413. INCANDESCENT LAMP; George M. J. Mackay, Schenectady, N. Y. App. filed March 25, 1916. Improvements.